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JULY
1952

No. 41 Vol. IV

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JULY, 1952

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Ceramics

VOL. IV JULY, 1952 NO. 41

THE PIPER AND THE TUNE

THE North Staffordshire Chamber of Commerce, presenting its annual report at the North Staffordshire Hotel on 30th July, 1952, was ever mindful of the recent contraction of the export market for pottery. The report adds that these unpleasant cuts provide a reminder of four well-known truths: (a) the country cannot indefinitely spend more than it earns; (b) we are dangerously dependent upon the goodwill of others; (c) competition must be met; (d) full employment created by exaggerated demands required active efforts to maintain it. More and harder work is the only solution.

Continuing to comment upon nationalisation, it says:

"In coal, gas and electricity, State ownership must now be accepted as an integral part of the industrial structure.

"Steel and transport, however, fall into a different category and are, in consequence, to undergo a process of denationalisation. These measures have evoked a threat from the Opposition to reverse the process on a return to power.

"Nothing could be more destructive to the stability of the country. Industry cannot afford to be a pawn in a political game which subordinates the national interest to party doctrines.

"In recording this opinion the Council intends it as a criticism of both the Right and Left wings, and more complete in inverse ratio to the degree of interference from any government."

It is confirming the comment made on this page in the April, 1951, issue of CERAMICS, which said:

"Any enterprise consists of its operatives on the factory floor, its management grades and its higher executives covering the sales, export and technical problems. Here there exists a wealth of practical experience far and away more realistic and useful to the nation than the paper jargon of the politico-economists. . . .

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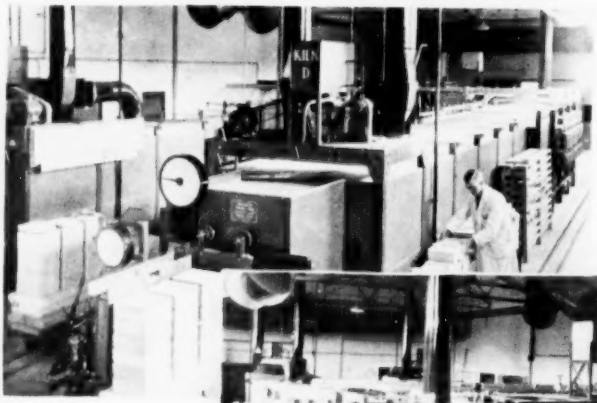

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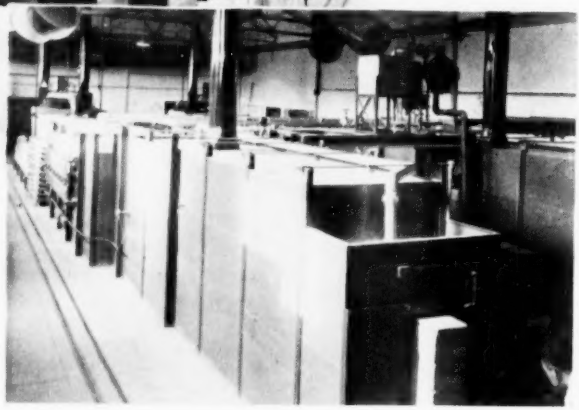

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PURCHASE TAX ON GLASS

by **ARGUS**

THE Glass Manufacturers' Federation are putting up a spirited fight in an attempt to save the hand-made cut-glass industry. Writing from their offices at 17 Manchester Street, London, W.1, they say:

"Hand-made cut glass is traditionally English. Lead crystal glass was invented by an Englishman in 1674. The number of firms engaged on it in Britain today can be counted on the fingers. It is an exquisite craft but a fast dying one.

"It is craft which is passed with pride from father to son down the generations. But today's sons are being forced out of the craft by excessive Purchase tax, closed and closing export markets and home market sales restrictions.

"One hundred per cent. Purchase tax is chargeable on each cut glass crystal article and, as each article is hand made involving several hours of work, as opposed to the speedy output of inexpensive machine-made glassware, tax makes the price of lead crystal cut glassware prohibitive to the consumer."

The Chancellor of the Exchequer may well ask:

"If I reduce the Purchase tax on British cut glass, how will I recover the revenue I get from it at present?

"Our reply is:

"The quantity allowed to be sold on the home market at present is so slight that you are gaining little from your 100 per cent. Purchase tax. As things are going you will lose even the small amount of tax levied now.

Free Cut-Glass

"Why not free cut crystal glassware on the home market from tax if this craft is to be retained. It is a defence matter too, for these men can make glass for radar, medical and scientific purposes.

"Others may ask:

"How is this a dying industry when there are export markets?

"But are there export markets? What about Australia. She can't buy our cut glass any more. The lead crystal glass industry received the closing of that export market as a crushing blow—the worst in one manufacturer's fifty year's experience. Designs made exclusively for Australia cannot be directed, for instance, to America, whose demands are for a different style of goods.

"Here in England today skilled craftsmen in glass cutting are being forced to turn from their long-practised and hard-learned art to work where their talents are wasted.

"Once gone from industry they are lost for ever. Daily the number of experienced glass cutters is diminishing.

"This can be prevented and we have shown how. Our warning cannot lightly be dismissed."

Attractive to Revenue Collectors

It is true that glass has forever been attractive to revenue collectors. As long ago as A.D. 220, a Roman emperor more or less taxed the new glass industry out of existence. It was imposed in Britain in 1745 and was doubled in 1777, causing a migration of glass workers to France and Ireland. There was the famous, or infamous, window tax which caused people to brick up their windows. The industry suffered the influx of Continental glass to Britain at below cost in the 1930's.

In another form the present-day Purchase tax is claimed by the Glass Manufacturers' Association to be delivering the final blow at home—there are only about nine firms making lead crystal cut-glass left in Britain and certainly the craft is threatened with extinction.

A meeting was arranged recently between Members of Parliament, the industry's representatives, and the trade union, for the industry faces the urgent problem of finding a market for 50 per cent. of its output following the import restrictions imposed by Australia, New Zealand and other countries. To tide it over difficult periods it does need some home sales and the 100 per cent. Purchase tax has

pretty well killed that possibility. Admittedly the number of people involved is relatively small and unfortunately in any consideration where there is Governmental interference with trade on the home market, those organisations which represent the biggest mass vote are the ones which, to a large extent, can call the tune.

Nevertheless, if we lose craftsmen overseas, one is in reality importing unemployment and reduced living standards to Britain.

Pottery has been an outstanding casualty in the restrictions of trade between countries of the Sterling Area. The sudden interruption of imports from this country by the action of the Government of Australia came as a shock to the industry in the midst of changing over from old-fashioned to stream-lined mechanical and automatic methods.

Continued Austerity

Amid the glories of the City of London's Mansion House, remote from the day-to-day toil of the Potteries, Mr. R. A. Butler, Chancellor of the Exchequer, emphasised a policy for continued austerity in home pottery marketing. ". . . for years now" he said, "we have longed to buy new decorated pottery on our home market but have denied ourselves. . . ." This categorical statement of self-denial, damped the hopes expressed for some weeks past in the pottery industry that the home market would receive some share of export-quality china as a means for maintaining the great new production potential to offset the set-back in overseas orders.

Mr. Butler went on to say that British industry had planned and must carry out an immense D-day invasion of foreign markets. He supported his general statement of policy with the plea that this was essential in order to pay for our imports of foodstuffs and raw materials. So far as the pottery industry is concerned in this respect he was talking to the converted. Pottery has every reason to be proud of its contribution to the development of our overseas trade. American reactions to this success were commented upon in the April issue of CERAMICS.

Whilst details of Mr. Butler's D-day invasion plans for foreign markets were being safely tucked into diplomatic bags and housewives were thanking their lucky stars if they should come across a sample of export-reject ware, in the sober-minded precincts of the Board of Trade a colleague of Mr. Butler's was sanctioning the issue of a few licences for sale on the home market of flawless wares of the highest quality in traditional and non-traditional designs. Had someone blundered?

A Body Blow

What Mr. Butler, and the Overseas Department of the Board of Trade have to learn, or perhaps the point has been missed or ignored, is that a long-term contraction of trade for the pottery industry must inevitably lead to a contraction of industrial potential, a slowing up of the process of re-equipment, and the jeopardising of that complex build-up in personnel and capital investments in the post-war years: a body blow to future export trade recovery. It has long been evident that there were signs of future distress in export trade and that in the case of the pottery industry some resiliency would be required to meet such adverse changes; relaxation of the controls prohibiting home marketing of decorated china is the only immediate alternative to what might be serious damage to the industry.

Mr. Butler's colleague at the Board of Trade has shown some understanding of that need and it is to be hoped that in that department the lesson has been learned that "for export only" is not enough to maintain the pottery industry in full working trim in the immediate circumstances.

The four million release for home consumption and the portended million for coronation mugs are just welcome palliatives.

The Australian View

Australian Government spokesmen say that the issue before them was one of bankruptcy. Their trade had developed a lop-sided aspect with a preponderance of imports reaching a dangerous point. For the immediate future it is possible that their interest will incline towards using Britain's ability to supply capital equipment rather than consumer goods. A

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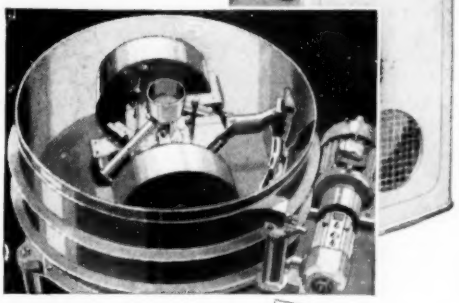

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revival of trade in consumer goods would seem to be dependent on a downward modification in the price range; an opportunity for Mr. Butler's department to play a not inconsiderable part in assisting the industry in its capital re-equipment.

A very important consideration is that conditions for trade between countries of the Sterling Area might remain at strain for a long enough period during which time time with countries outside the Sterling Block could conceivably increase. The volume of production in Western Germany has undergone an increase by some 40 per cent. since a year ago, on the basis of a standard much lower than that of our own country. Japan, inspired or sponsored by the United States, has rebuilt its pre-war marketing organisations in readiness to go all out with its cheap imitations of leading lines. Here again low-paid labour and poor working conditions make a most unfavourable comparison with our own country. Where is the U.N.O. Charter?

Even in America envious eyes are turned towards the place which British pottery has won in their markets.

Of course, it is as Mr. W. G. Barratt, chairman of Barratt's, of Burslem, Staffordshire, said recently: Continental and Far Eastern countries were already taking in our overseas markets and unless some way can be found to cheapen our productions, he feared very much for the bulk of the trade in Stoke-on-Trent. His answer: "Good quality at competitive prices," is the only real answer. That in turn brings up the question: "How can the cost of living be reduced and, therefore, wage restriction bring about lower costs?"

Cutting National Overheads

Broadly speaking it is a question of cutting the national overheads. Undoubtedly productive industry, which includes management and men, is still throttled by many extraneous and non-productive bodies which in turn are absorbing millions of pounds and in many cases are disguising the real useful employment figures. Neither band of politicians is prepared to tackle this major problem and meanwhile the national money-spinners—productive workers and management—remain as a shuttle-cock between the politicians, the financiers and the trade union hierarchy.

Industry is being planned by text-book economists, criticised by more economists who in many cases have toiled not—and spun only yarns—and administrated by clerical minds. Yet industrial management and men who should have the greatest national say on the basis that he who pays the piper calls the tune, are left to herald their cause by a fanfare of tin whistles.

EXHIBITION OF VICTORIAN AND EDWARDIAN DECORATIVE ARTS

In October, 1952, such an exhibition will take place at the Victoria and Albert Museum.

Looking for exhibits the museum authorities are not so much concerned with the everyday productions popularly associated with Victorianism, but rather the works of pioneer designers in furniture, textiles, carpets, pottery and so on. Apparently there is some difficulty in getting hold of exhibits due to the dislocations of two world wars.

In the field of pottery and ceramics, the museum authorities say that they are still searching for further information. Sufficient material has been gathered to represent the work of most of the potters and potteries, but the authorities are looking out now for the wares of Cauldron Place (Ridgways until 1855 and later Brown-Westhead, Moore), Brownfield's Guild and the Devon pottery of Eramington. They would be very happy to know of any outstanding pieces from these potteries which can be closely dated or attributed to popular designers or painters.

If anyone can help the exhibition organisers, would they communicate with Mr. Hugh Wakefield, Assistant Keeper, Victoria and Albert Museum, South Kensington, London, W.7.

Laboratory Porcelain

(SPECIALLY CONTRIBUTED)

UP to the 1914-18 war, laboratory porcelain was almost a German monopoly, though it had been made in this country for a few years around 1850. When war came supplies of this highly important material for the chemical industries were cut off, and it became necessary to produce it at home. This was successfully done at Worcester, and thanks to the enterprise of the British ceramic industry, aided by a certain amount of protection, there was no undue scarcity of laboratory porcelain when the second world conflict came upon us.

Laboratory and domestic porcelain do not differ very much in manufacture, but in the case of the former material it is very essential that it should resist heat and thermal shock, and the attack of the common laboratory reagents. It must be mechanically strong to avoid accidental breakage. All these points are seen to be the more important when it is realised that the breakage of a crucible or basin may mean the loss of a week's work by a skilled analyst. Compared with the cost of this, a few shillings extra spent on the purchase of reliable laboratory ware will be a very worth-while investment.

Raw Materials

For obvious reasons, very little information is available on the composition of the bodies used. It is commonly stated in text-books that the ordinary hard-paste porcelain body is used. Emile Bourry[1] states that in a general way the percentage alumina is rather higher in a heat-resisting porcelain. He gives the following analysis for a French fireproof porcelain:

Silica	61·61 per cent.
Alumina ..	30·01 per cent.
Ferric oxide ..	1·56 per cent.
Lime (CaO) ..	3·56 per cent.
Potash (K_2O) ..	3·26 per cent.

The raw materials used are similar to those required for hard paste porcelain, namely china clay, felspar, and quartz. Continental practice varies from manufacturer to manufacturer. Some employ only felspar and china clay, following the original practise of the Chinese, and bodies using, for example, 77 per cent. of china clay and 23 per cent. of felspar have been described. Others add quartz to the mixing, e.g., 55 per cent. kaolin, 23 per cent. felspar, and 22 per cent. quartz. Additions of plastic kaolin also appear to be used to increase workability. Ground pitchers are used in some of the larger articles, and recipes have been given using 40 per cent. ground pitchers, 10 per cent. felspar, and 50 per cent. china clay. The pitchers are ground to about the same fineness as the other milled materials.[1]

Body Preparation

Body preparation differs in several respects from that with which we are familiar in this country for earthenware and china. The felspar and quartz are ground separately in cylinders until approximately 60 per cent. of the particles are finer than 0·01 m.m. in diameter. The kaolin is blunged in a separate blunger and lawned through about a 160s lawn. Some manufacturers take special precautions to free the kaolin from quartz by washing over the clay in a stream of water in an elutriation process. This refinement is not considered necessary by others, who, in any case, add quartz to the body. The ground materials are mixed with the clay slip in a mixing ark in the usual way, and after lawning and magnetting, the body is dewatered by pressing up in a filter press. A typical time for this is about 2½ hrs. with a finishing pressure of about 80 lb. to the sq. in.

Continental factories often use circular press plates of a relatively small size, claiming that this give a more consistent press cake. It does not, however, always avoid the soft centres that have encountered at times with other types of filter press.

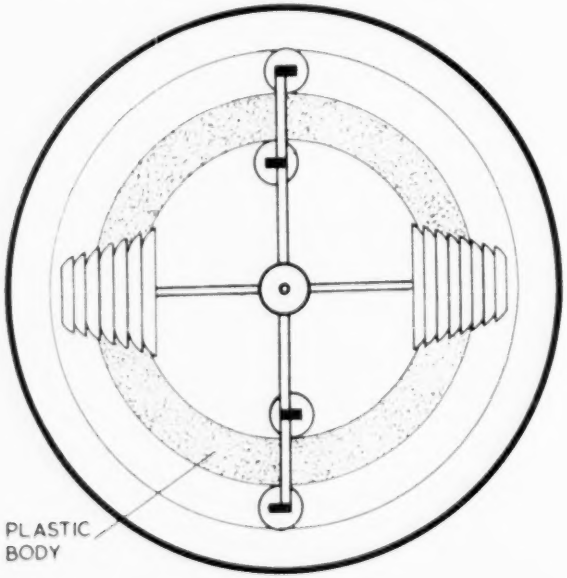
The filter cakes are then treated on

a kneading table to even up the water content and plasticity. This machine is not used in this country, where the clay is homogenised with pug mills. De-airing pug mills are now gradually replacing the kneading table on the Continent, but it is still widely used at the present time. It consists of a circular table covered with some non-rusting metal such as aluminium or zinc. The clay is worked on this (Fig. 1). It is fitted with two horizontal arms, located at right-angles to each other, which can rotate above the table in a horizontal plane. They are held on a verticle spindle located at the centre of the table. One arm carries two large rollers which do most of the work on the clay. These are mounted horizontally. The other arm carries a series of smaller rollers which can rotate around vertical spindles.

The net result is that the plastic body is eventually converted into a ring of material of similar cross section to that which is normally extruded from a pug mill. The ring is cut up into pieces of suitable length and sent to the potters. The operation is intermittent, and the machines can deal with amounts varying from 3 cwt. to about 8 cwt., depending on the size. About 20 to 30 min. is taken for each kneading operation. Compared with the pug mill this is a slow speed and it is not surprising that in modernised factories it is losing favour. As with many changes in our own country, this one has not been unaccompanied with head-shakings on the part of the more conservative-minded. Porcelain tends to be a short body, and, to improve it for working, ageing for as long as possible is usual. Depending on production this may range from a few days to two or three weeks.

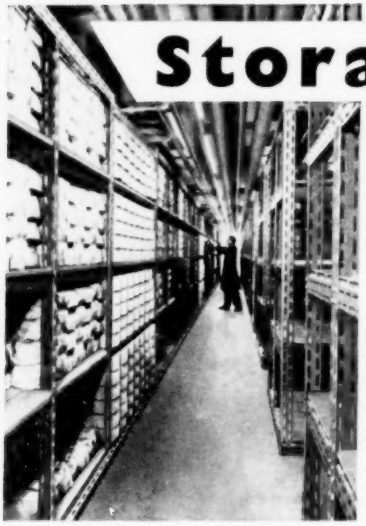
Microstructure of the Fired Body Important

The heat-resisting properties of the laboratory porcelain depend, to a very large extent, on the microstructure of the fired body. It should contain no free quartz, which, as is well known, is liable to sudden expansions and contractions at the inversion points of silica. This might result in shattering of the body. The aim in firing, therefore, is to convert all the free quartz to crystals of mullite. This is a substance of low expansion, and its crystals form interlocking needles which bind together and confer mechanical strength. The conversion



PLAN

Fig. 1. The kneading table



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of the quartz to mullite is effected by firing to a high temperature, and it is assisted by fine grinding of the materials. For this type of ware the raw materials are ground finer than for ordinary table ware.

Shaping and Firing

Shaping the articles is done by the usual methods. Crucibles, basins and beakers are jollied, while intricate shapes, such as funnels, are cast. In making large dishes or other shapes involving the handling of large clay bats, particular care must be taken not to strain the clay in transferring it to the mould if crooked ware is to be avoided in firing. For this purpose the clay bat is lifted on a cloth stretched in a frame resembling a tambourine. This is placed on the batting-out machine, the clay placed on the cloth, and the bat spread by the machine in the usual way. The operative then uses the tambourine to remove the bat and to transfer the clay to the mould. The cloth and frame are then removed and used again. The operation is completed by jolleying in the usual way. After drying, the ware is fettled and placed for firing.

The firing of porcelain differs in several important aspects from that adopted for the types of ware made most commonly here. Intermittent firing is still common, and is carried out in round kilns divided into two, or even three compartments. These operate at different temperatures so that the hotter is used for the glost fire, and the cooler for the biscuit, or hardening fire. This is, of course, different from the method adopted for china and earthenware, where the biscuit is fired at a higher temperature than the glost. Where the kiln has a third deck this is used for drying purposes. The practise, therefore, is to fire the biscuit at 800-900° C. in the top of the kiln, and the final, or glost fire, in the bottom (Fig. 2). The chambers of the kiln are connected by a flue, and the whole works on the up-draught principle. The hardening fire aims at making the biscuit sufficiently strong to stand the dipping operation. For heavier pieces of porcelain the clay ware may be dipped and the articles once-fired. By

our standards the biscuit is excessively soft and porous. In this condition it readily absorbs the glaze which is applied by dipping.

In some of the more modern factories the hardening fire is now done in about 12 hrs. by passing the ware through gas- or electrically-heated kilns with metal belts similar to those used in this country for glost and enamel firing. Firing is complete in about 12 hrs., and, since the temperature is comparatively low, the life of the metal belt is good.

Glost or High Temperature Fire

After the usual cleaning and dipping and drying, the ware is given the final fire at high temperature. In the case of laboratory porcelain this is done at a maximum temperature of around 1,450° C. On account of the high temperature the intermittent, or globe kilns, are seldom more than 16-20 ft. in diameter. At such an elevated temperature only a felspathic type of glaze could be used. A typical formula is:

$$\left.\begin{matrix}0.3\ K_2O \\ 0.5\ CaO \\ 0.2\ MgO\end{matrix}\right\} \cdot Al_2O_3 \cdot 10SiO_2$$

and this matures at 1,430° to 1,460° C.

It is normally compounded from sand, china clay, pitchers, marble or chalk, and talc or magnesite. This is ground in a cylinder and used at a pint weight of about 28 oz. Both glost and biscuit pitchers have been used, and sometimes calcined china clay is added. The ware is heated in saggars, and firing takes about 50 hrs. upward, depending on the size of the kiln. About the last 12 hrs. of firing are done in a reducing atmosphere. The purpose of this is to whiten the body. The small amounts of iron compounds normally present in pottery bodies tend to give off-white colours. In earthenware, for example, the ferric compounds produce a tendency to a cream or ivory tint. This is neutralised to give a white body by the addition of minute amounts of a blue cobalt stain.

In firing porcelain the much higher temperature produces not an ivory tint in the body, but a much darker shade, and the presence of a cobalt stain only serves to intensify the dark colour. The white colour is produced in this case by a reducing atmosphere, which is supposed to produce a mixture of blue ferrous and yellowish ferric compounds, the colours being complimentary and producing a white body.

Tunnel Kilns for Firing Porcelain

Since the end of the last war considerable modernisation of European porcelain factories has been undertaken, and tunnel kilns are now in operation for the final high temperature firing. In these it is necessary to maintain reducing conditions in part of the tunnel continuously.

V. Bodin has described tests carried out with two of the earlier French tunnel kilns. The biscuit fire was done in two small tunnel kilns 20 and 32 metres long, and was completed in 12 hrs. in each case. The glost or final fire, of course, took longer, and in one case it was 42 hrs., and in the other, 58 hrs. The kilns were about 60 metres long and were fired by gas. In one case the maximum temperature was 1,350° C. and in the other, 1,300° C. The shorter time was achieved by a more rapid cooling.

The firing cycle, adapted from V. Bodin's results, is given in Fig. 3. It

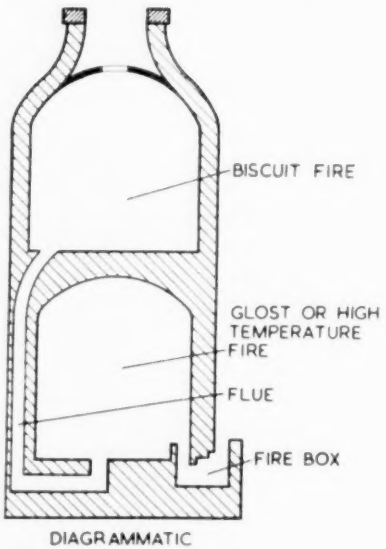

Fig. 2. Intermittent kiln for firing porcelain

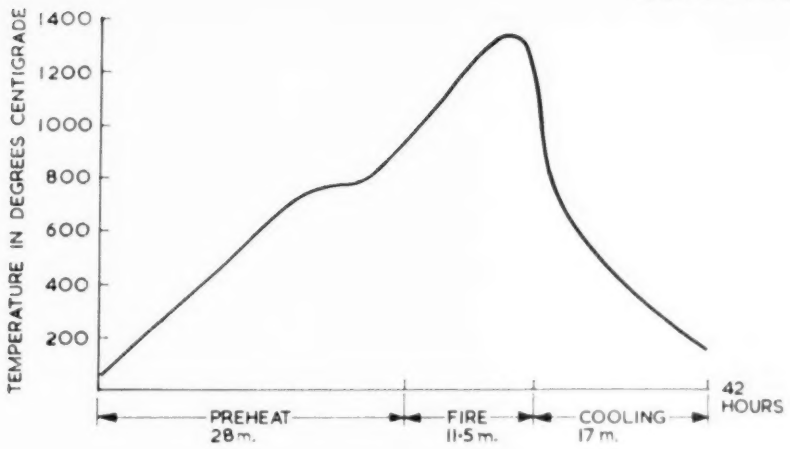

Fig. 3. Firing curve for porcelain

(After V. Bodin.)

shows a steady temperature rise to 800° C., where the rate is slowed up for a few hours, followed by a similar rise to within about 50° of the maximum temperature. A brief period of a few hours is taken to attain the finishing temperature, and then rapid cooling to 900° C. follows. Thereafter the rate of cooling is slower. Reducing conditions begin at about 800° C. on the upward part of the cycle. The advantages already found in tunnel firing other types of ware have been repeated in the case of porcelain.

Specification for Laboratory Porcelain

Needless to say, laboratory porcelain has to withstand far more rigorous conditions than ordinary table ware, etc. For this reason its manufacture is carefully controlled by laboratory tests. A series of standard tests have now been formulated between the manufacturers and the various users, and in this country these have been embodied in a British Standard Specification.[1] These tests cover porosity, resistance to heat and thermal shock, and resistance to acids and alkalies. Details are given of the standard methods to be adopted in these tests.

Porosity

The body must not be porous, and the glaze must be free from pin holes and other blemishes. To test this the specification recommends immersing the articles, including broken pieces with body exposed, in a 0·5 per cent. solution of the dye eosin for 18 hrs. As part of the test, containers may also be filled with the dye. After the recommended time the articles are washed, wiped dry, and examined under a lens. The staining action of the dye will reveal imperfections in the glaze and porosity in the body.

Resistance to Thermal Shock and Heat

The test described for this in the specification is meant to apply to ordinary crucibles not more than 46 mm. in diameter. It is not suitable for Gooch crucibles, etc. It is understood, however, that these articles are made from the same material as the crucibles which pass the test. Prior to the heat test the crucible is cleaned in 50 per cent. hydrochloric acid (by volume), washed, dried and heated in a steam oven. This removes any eosin from the porosity test.

The heating test involves maintaining the crucible at 250° C. for 15 min., followed by dropping it into a bucket of water 6 in. below the end of the furnace. The latter is a vertical tube 24 in. long and of 4 in. internal diameter, wound on the outside with a suitable heating wire, and lagged. The temperature is recorded by a thermometer or pyrometer, and the crucible

is held in the furnace, bottom downwards, in a wire cage. After the heating has been done the crucible is dropped, in its cage, into the water, which is at a temperature of 15° C. It is then examined for cracks and crazes. Good samples of British ware will stand heating to a higher temperature than that required by this test without failure on quenching in cold water.

Resistance of the Glaze to High Temperatures and Test for Constancy of Weight.

The significance of these tests will be apparent when one realises that in analytical work it is essential that the containers used in the heating operations shall not change in weight, and that they must not fuse on to the contents. The test recommended for this is to place some pieces of broken porcelain in a dish of the same make, so that the biscuit is in contact with the glaze. After drying by gentle ignition, the dish and pieces are weighed. They are then heated for 2 hrs. at 950 -1,000° C. in a muffle kiln and cooled. The change in weight shall be $\leq$ 0.1 mg/10g. and there must be no sticking of the pieces as a result of the heating. British ware can be heated to a higher temperature than that specified above before softening of the glaze begins.

Resistance to Acids and Alkalies

It is obviously undesirable that the common laboratory reagents should dissolve out materials from the basins, crucibles, etc. The standard test for resistance to acids and alkalies involves heating the articles under test with solutions of hydrochloric acid, sodium carbonate, and caustic soda of known strengths at 100° C. for 4 hrs., and weighing the article before and after the test to ascertain if any change in weight has occurred. In the case of the acid, a constant boiling solution of hydrochloric acid is used, so that there shall be no question of the concentration of the acid changing during the test as a result of vaporisation. The vessel is three-quarters filled with the acid, covered with a clock glass, and heated on a steam bath. Similar tests are carried out with N-sodium carbonate solution and 5 per cent. caustic soda solution. The losses in weight must not exceed 1 mg. per sq. decimeter of surface exposed in the case of hydrochloric acid, 10 mg. in the case of sodium carbonate solution, and 60 mg. for the caustic soda solution.

Again, good British laboratory porcelain gives losses well below these limits.

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FLAME FAILURE CONTROL FOR OIL BURNERS

THE Rheostatic Co. Ltd., of Slough, Bucks, announce that they have recently completed development and field trials of a new photo-electric protective device which is sensitive to the flame of automatic and semi-automatic oil burners.

The application of a photo-electric cell to oil burner flames is not new, but in developing the "Satchwell" type the Company had in mind the necessity for producing a device which will prevent operation of the oil burner not only on non-establishment of the flame during starting or failure of the flame during running, but also on the occurrence of those troubles which are likely to occur even with well managed installations.

In general, the device is designed to stop the oil burner if the flame is not established during the starting operation and also to stop it should there be a failure of the flame for any reason during a normal run. In addition to these occurrences, the oil burner will be stopped should either the photo-electric cell or the amplifying valve be broken; if one of the external electrical connections to the device is broken or otherwise open circuited; if a path of low resistance is created between the terminals of the photo-electric cell caused, for instance, by operation in an exceedingly dirty boiler house; of if an electrical short circuit develops across the terminals of the photo-electric cell by damage or otherwise. As far as possible it has been ensured that any abnormal condition arising in connection with the device or its associated equipment will cause the oil burner to be stopped.

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THE AMERICAN MARKET

by

JOHN WEDGWOOD

THE citizens of the United States are, on the average, more conscious of the importance of interior decoration than those of any other country. I do not mean that their decoration is necessarily better than any other, but merely that they are more actively anxious to make their homes attractive. Indeed, it might be said that, on our standards, Americans decorate beyond their means. They spend a greater proportion of their income on beautifying their houses than we do.

This can be attributed partly to the influence of the American magazines which devote so large a part of their space to striking colour photographs of domestic interiors.

Bridal Service

Another influence is the Bridal Service given by most department stores in the U.S.A. When a wedding is announced it is often made known at which store the couple will furnish their home. Both bride and bridegroom will inspect everything, accompanied by an interior decorator belonging to the staff of the shop, to whom they give a list of everything they would like to have. When the guests go there to buy their presents they are told of the preferences which have been expressed. In this way it is even possible for a dinner service to be purchased almost piece by piece by different guests. This enables the young couple to possess many things which in this country would be regarded as beyond their means. I do not think that such a system could be worked satisfactorily in Great Britain. Too often wedding guests come from places hundreds of miles apart. They would not easily be able to buy their presents from the same shop.

In the U.S.A., however, single large cities lying a great distance from one another tend to be the centres of culture and sophistication for a considerable area. These cities are often dominated by one or two great department stores.

The Bridal Service is given not only by the larger shops but also, for example, by jewellers, who endeavour to provide the same facilities in their more limited sphere. The American jeweller stocks a wide range of different things, including fine pottery.

From the moment the two young people become engaged they begin to think about interior decoration. The American is a highly competitive society and the philosophy of "keeping up with the Jones's" plays an even more important part in the U.S.A. than in our country. Each bride wants to furnish better than the next or than her friends already married.

British China

British bone china has a particular attraction for the American public, not only because of its excellence of design, whiteness of body, and durability, but also on account of the special glamour which has become associated with this unique product. To possess a bone china service is the ambition of many housewives in the U.S.A. They will pay what, in our eyes, seem high prices; for example, $14 would be quite cheap for a "place setting" consisting of three plates, meat, dessert and tea, and a cup and saucer. With four such sets it is possible to have a dinner party. The Americans save money by not requiring to have the serving pieces in bone china, or, alternatively, they use vegetable dishes of stirling silver, which would be regarded as a permanent investment.

Market research leads to the conclusion that in the U.S.A. bone china

services at these prices and even higher are purchased by persons with incomes as low as $4,000 a year. This is actually below the average family income for the country as a whole. Such china is regarded as an investment. It is expected to last for a long time. During their married life the American husband and wife are quite likely to redecorate their house several times but they may not renew their dinner service. It will, therefore, be required in a colour scheme which will fit in with the changes they may make over thirty or forty years. This is one of the important things which must be borne in mind when designing for the U.S. market.

Climatic conditions also must not be overlooked. They are different from those here. In general the weather is warmer, drier and brighter. This is especially so in the south, particularly in California where developments in taste have much influence throughout the U.S.A. The result is that the American generally likes brighter, cleaner colour schemes than those popular in this country. However, it is difficult to generalise. Our art director points out that at this moment among the most popular colours are earthy celadons and greys.

Informal Design

In recent years there has been a tendency to eat out-of-doors, especially in the warmer seasons. New houses are often of the ranch type or built with a patio. Domestic servants are almost unknown except among the very rich. This has led to informality in the serving of meals and cafeteria methods. Informal design has, therefore, become increasingly popular.

To meet this demand, American pottery manufacturers have made great efforts to produce striking and informal designs. This aspect of the U.S. market has been largely neglected by British manufacturers who have regarded it as wiser to concentrate on more patterns for indoor use. Furthermore, it is designs of this sort which the Americans normally wish and expect to purchase from Britain. For the exciting and informal they look to their own potters. There is no reason, however, why the British manufacturers should not compete in this sphere also, as soon as they are less oversold.

Eating habits in America are different from those in this country. People tend to use a fork only, held in the right hand. They sprinkle salt and pepper over their food instead of putting it on the side of the plate. Plate rims are, therefore, beginning to vanish.

There is a last point which I will add. The U.S. market for British furnishings, etc., as a whole, is not likely ever to be very large and will always be highly competitive.

Australian Market

For many years Australia will be of greater importance to our manufacturers. It is not sufficiently realised how great is the American influence on Australian taste. Not only do American magazines circulate widely in Australia, but the climate and the outdoor living are also similar. The domestic service situation in Australia is even worse than in the U.S.A. American cultural influence is increasing in the Commonwealth.

So far, exports to Australia have been insulated from American competition by the dollar shortage which prevents Australians from buying American goods. This will not continue for ever. It is likely, therefore, that an understanding of American taste will prove of increasing value for Britain in the more important market in the Comonwealth.

UNEMPLOYMENT FIGURES

THERE were 2,825 registered unemployed in Stoke-on-Trent on 16th June, including 1,808 who were temporarily stopped.

This compared with 438 on the Employment Exchange registers and only 14 temporarily stopped a year ago.

These figures have been given to Mr. A. Edward Davies, M.P. for Stoke-on-Trent North, by Mr. Harold Watkinson, Parliamentary Secretary to the Ministry of Labour, as undertaken in a written reply on 19th June to questions about unemployment.

Mr. S. C. Anthony.—Mr. S. C. Anthony has left Henry Wiggin and Co. Ltd., to take up an appointment as assistant works manager with The Ever Ready Co. (Great Britain) Ltd., Edmonton, London, N.18.

OPEN DISCUSSION

AN all Association Meeting was held in Hanley Town Hall on Wednesday, 18th June, 1952, with the president, Mr. D. Salt in the chair.

The meeting took the form of six 5-minute talks given by members of the Association, and each talk was followed by a 10-minutes' discussion.

The first talk was given by **Mr. H. Hulse** of the Longton and Fenton Branch, whose subject was "Glaze Spraying." After outlining various methods used, Mr. Hulse gave some information about trials carried out with a view to obtaining a machine to automatically spray table ware with glaze. Various experiments were tried out with prototype models, a two-booth arrangement being finally arrived at, with the ware carried forward on tiles on a travelling wire. He said that work was now in progress to design a machine to do this job based on the findings of the work done with the prototype, and that he was confident that a successful apparatus would result. The main difficulty with automatic spraying is that a reasonably even porosity of the biscuit body must be ensured throughout the run of the ware. He had found that 33 oz. pt. weight was ideal in conjunction with a fairly porous body with an addition of a dope such as cellaphas. Experiments carried out on recovered glaze showed that it had lost none of its properties, and that it could be re-used.

Mr. G. Mountford of the Stoke and Hanley Branch spoke on "Quality Control." He said that during the war years quality tended to fall, but now the aim was to recover and surpass the quality of pre-war years. He pointed out that in warehouses with a large number of selectors, each one would have a different idea of the quality required unless some form of unifying their efforts was employed. The person in charge would know what quality had been decided upon by the directors, but various interpretations of that standard would exist with the different operatives. He pointed out that it was true to say that the profits or losses of the company was in the hands of the selectors, and the only way to ensure that they did not reject or put out for further treatment ware which was in fact recoverable was in the spot check method by the person in control, who would daily inspect sample lots of ware dealt with by each person, pointing out incorrect selection on the spot and keeping a record of his findings so that operators who were working away from the standard consistently could have special attention paid to them. The degree of recovery of faults is of vast importance to the final profit.

Mr. L. Unwin of the Burslem and Tunstall Branch took "The Mining of China Clay" as his subject, and described a visit to a clay mine. He said that this was 40 or 50 acres in size and 200 ft. deep. Over 6,000 tons of material were mined to obtain 1,000 tons of clay. Very high pressure water jets were played on to the clay and the resulting streams of slip were run into setting tanks, rough settled and the fine particles pumped to the refining section. Various methods of separating out the mica and heavier particles were employed and the final true china clay was then dried in tanks, or dehydrated in iron presses holding from 5 to 6 tons. He said that he found a deep desire on the part of the mining industries to co-operate with the pottery industry, and they were engaged upon chemical and analytical tests of clay prepared by old and new methods to ensure that nothing in the new methods was detrimental to the clay as required by the pottery industry.

Mr. A. Clough of the Longton and Fenton Branch gave a brief résumé of his experience of "Biscuit Tunnel Firing," and said that open placing, as opposed to saggar placing, was the thing to aim for. Amongst its many advantages was the fact that ware was always visible on the trucks for

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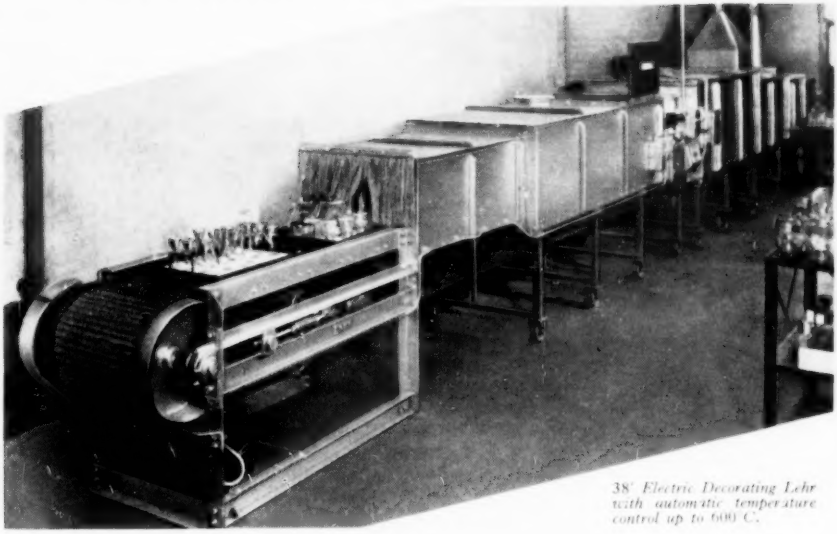

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checking the placing, etc., and that firing faults could be viewed on the truck with the ware still in the position in which the faults occurred. He said that 100 per cent. looking over of the clay ware should bring nearly 100 per cent. results as far as quality went. The temperature gradient in the early hours of firing was of vital importance to the quantity of split ware, and crooked ware was mainly caused by the movement of sand on setters due to the handling of trucks. This was particularly noticeable when trucks stood for some time before going into the oven.

Mr. F. Timmins, the association secretary, at very short notice gave a talk on "Sales Organisation." He said that under new regulations the earthenware section of the trade was likely to sell more on the home market than china, and that those firms who had exported most in the past would be able to sell less in the home market. He reviewed the advantages of employing an importer as against an agent on commission for dealing with export markets, stating that an agent had many advantages and was in his opinion the most satisfactory method to employ. He pointed out that in the U.S.A., import duty meant that for each 1s. an article cost from the factory, a price equivalent to 3s. 6d. would rule in the U.S.A., whereas in Canada, with no 5 per cent. import duty, the price would be cheaper to the retailer, and that a large amount of ware that was sent to Caada did in fact find its way back to America by the tourist trade, and that this fact should be catered for when reviewing decorations for the Canadian market. He said that there was a vast amount of business to be done in South America and that exploration and exploitation of new markets would become increasingly important to the industry in the future.

Mr. J. Ratcliffe of the Burslem and Tunstall Branch chose "Potting Tomorrow" as his subject, and said that world competition will force down prices in the future, and the cheap mass production of good quality will be of increasing importance. Potters' efforts in the future will work towards this aim. Labour-saving and automatic machinery will become more and more necessary, and such things as automatic making, throwing and glazing are likely to develop. Laboratory work and checking of standards will be of vital importance; as for automatic machinery the standardisation of all materials used was an essential factor. He thought that the tendency would be for earthenware to become more vitreous and china to become more plastic. Dust pressing was likely to be used for certain processes, and he also thought that a once-fired product of good quality would also be obtained, and that specialists would become more and more essential and be key members of any firm.

CHINA CLAY

A MEETING of the South-Western Section of the Society of Chemical Industry was held jointly with the local section of the Royal Institute of Chemistry at The Technical College, Plymouth, recently, when a lecture was delivered by Mr. N. O. Clark on "China Clay."

The lecture opened with a description of the nature of china clay and dealt with the range of sizes and form of the crystallites. The larger particles of 100 microns were in the form of a concertina decreasing in complexity down to the smallest at 0.2 microns which were simple 120-angle plates.

The physical effects of flocculation and deflocculation were discussed and the effects of particle shape and particle size distribution on the rheology of aqueous systems. The effects of particle shape and size on the dry strength of clays were mentioned and the effects on this property of adsorbed water layers.

Reference was made to the commercial uses of china clay in the light of its physical and chemical properties, particularly its use in the manufacture of paper and ceramics.

R. H. Houstoun—Mr. R. H. Houstoun, managing director of the Thermal Syndicate Ltd., retired from his appointment on 30th June, and Mr. F. J. Edwards has been appointed managing director as from 1st July, 1952.

Acheson Colloids Ltd.—Acheson Colloids Ltd., manufacturers of the well-known "dag" colloidal graphite and other dispersions, have recently opened a West of England office at 103 Promenade, Cheltenham. Telephone: Cheltenham 3847.

INDUSTRIAL USES OF REFRACTORIES

by

W. P. HOWELLS

PART I

IN order that a furnace or components of a furnace may be operated to give the greatest possible economic service, it is necessary to consider the three principal factors involved. These are:

1. Operating conditions of the furnace (e.g., temperature, oxidising or reducing atmosphere, presence of carbon monoxide, spalling conditions, composition of slags, mechanical abrasion, etc.).
2. Design of the furnace (including the design of the refractory).
3. Type of refractory (e.g., silica, siliceous, firebrick, aluminous or other refractory).

The operating conditions of a furnace often become more exacting during its life, due to a demand for increased output. Thus, working temperatures may be increased, heating and cooling cycles may become more frequent, and a greater throughput of charge may be required. These factors have a great bearing on the life of a furnace.

Furnace Design

The furnace design influences the general operating efficiency, and has a direct bearing on initial brickwork cost, brickwork maintenance and fuel cost. The writer recalls an instance of the repeated early failure of a water-tube boiler arch. Numerous grades of refractory bricks were tried in an attempt to find one type which would give a reasonable life. Eventually the whole arch was raised several inches, and the design was slightly modified to prevent high velocity dust-laden gases impinging directly on the arch. As a result of these alterations, it was found that an ordinary high-grade firebrick (39 per cent. Al_2O_3) gave excellent service where previously high alumina refractories had failed.

Selection of Refractory

The selection of a particular grade of refractory for a specific application will depend on the conditions operating in the furnace and on a reasonably extensive knowledge of the properties of commercial refractories. Often the final choice will be the result of a number of service tests carried out on various brands and types of refractory. A common way of assessing the value of a refractory is to determine the weight consumed per ton of furnace output; this method is useful when the consumption of the refractory is high, as, for example, in the open hearth steel process or in glass melting furnaces. In positions where the refractory normally lasts for a considerable number of years, the choice of refractory is often left to the experience of the furnace builder or the manufacturer of the bricks. Alternatively the choice may be made by considering the chemical and physical test results published by the manufacturer for the various grades he may produce.

The most expensive grade of refractory is by no means generally the most suitable for any particular application. For instance, high-grade aluminous firebricks employed in the walls of a shaft kiln would soon wear away by mechanical abrasion. A cheap, low-grade firebrick having a hard texture would give a considerably increased service life. However, the selection of the *correct* refractory at a somewhat higher initial cost is

generally soon offset by the increased output per brick cost. Furthermore, the cost of transportation and building of high-grade refractories is no more than that for low-grade refractories.

While the selection of a refractory for a particular use will depend on a fairly extensive knowledge of commercially available products, it may be of assistance to note that:

1. Silica bricks (greater than 92 per cent. SiO_2) do not collapse under load until temperatures approaching their refractoriness value are reached. Silica bricks have a poor spalling resistance at low temperatures.
2. Good volume stability is obtained from bodies in the siliceous fireclay group, i.e., 75-92 per cent. SiO_2.
3. High porosity in firebricks usually indicates a reasonable spalling resistance, but low mechanical strength.
4. Increased alumina content in fireclay refractories gives greater refractoriness, and generally increases resistance to slag attack.
5. Sillimanite refractories combine strength at elevated temperatures with good slagging resistance.
6. Basic refractories are mainly confined to metallurgical furnaces where their chemical composition may assist the metallurgical operation in addition to their normal function as constructional materials.

Consumption and Application

The annual consumption of refractories in this country during 1951 was given as:

Fireclay bricks ..	1,000,000 tons
Silica bricks ..	250,000 tons
Basic bricks ..	60-70,000 tons

The bulk of refractories are used in the iron and steel industries. The following figures illustrate the industrial dispensation of refractories in Great Britain:

	%
Iron and steel industry ..	50
Non-ferrous industry ..	5
Gas, electricity and power ..	20
Cement industry	5
Glass industry	5
Ceramic industry	5
Chemical industry	5
Other industries	5

Iron and Steel

The greatest differences in the properties of cast iron, wrought iron and steel are mainly due to carbon, either graphitic or in the combined state. The blast furnace produces pig iron from iron ore, and it is from pig iron that all other forms of iron, steel, and ferrous alloys originate. The process of manufacture of pig iron, wrought iron, cast iron and steel is controlled to give the ultimate percentage of carbon within desired limits. Other elements present in the finished metal are also controlled.

Table 1 shows the usual limits for these elements.

TABLE 1.

	C	*Si*	*Mn*	*S*	*P*
Pig iron	2 -4·5	0·5-4·5	0 -2	0-0·2	0-1·75
Wrought iron	0 -0·25	0 -0·1	0 -1	0-0·15	0-1·75
Mild steel	0·1-0·5	0 -0·3	0·3-1·0	0-0·8	0-0·8
Steel	0·5-1·5	0	0 -0·3	0	0
Cast iron	2·5-3·5	1 -2·5	0 -1	0-0·15	0-1·75

Pig Iron

Pig iron is produced in the blast furnace by blowing hot air upwards through descending layers of iron ore, coke and flux. The carbon and carbon monoxide reduce the ore to the metallic state, while the flux unites with the gangue to form a fusible slag. The fused metal and slag flow to the well of the furnace, the slag floating above the heavier metal. The metal and slag are tapped off at intervals.

The general layout of the blast furnace is shown in Fig. 1.

Refractories in the blast furnace are required to resist abrasion from the descending burden, to resist erosion from the ascending dust-laden gases and to withstand corrosion from slags and gases.

The stack of the furnace should be constructed of bricks which will resist mechanical abrasion from the descending burden. In addition, the bricks should have a low permeability in

order to reduce penetration of carbon monoxide and alkali vapour. For these reasons, it is usual to manufacture the bricks in high-pressure machines. Furthermore, while it is desirable to have large blocks in order to reduce the number of joints required, it is difficult to obtain large sizes without increasing the porosity. As a result, the most common sizes in this country are the 13½ in. by 6 in. by

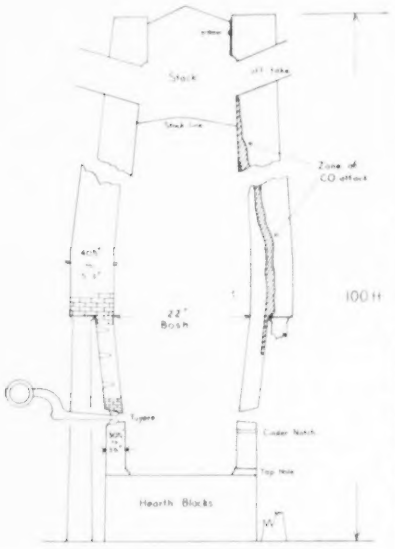

Fig. 1. General layout of blast furnace

3 in., and the 9 in. by 6 in. by 3 in. bricks.

In the presence of metallic iron carbon monoxide is decomposed and carbon is deposited. When this happens in the pores of a firebrick the brick is rapidly disintegrated. The rate of decomposition is greatest between 400° C. and 600° C., and as these are normal temperatures in the blast furnace stack, carbon monoxide disintegration is a common form of failure in this zone. It is therefore important to choose a firebrick, the iron form of which is not readily reduceable to metallic iron. Fig. 2 illustrates the widely differing behaviour of various firebricks in this respect. The three bricks in the illustration were heated to 450° C. in an atmosphere of carbon monoxide.

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Brick (a) shows no signs of disintegration; (b) is badly fractured, while (c) has completely disintegrated. The use of china clay bricks (free from reducible iron compounds) has shown improved resistance to carbon monoxide attack. Experiments with carbon bricks are in progress.

The most generally used brick in the stack are those of the 35-39 per cent. alumina type. It has been found that bricks of reasonably high alumina content resist alkali attack with reasonable effect, as alkali-alumino-silicate slags are more viscous than those higher in silica.

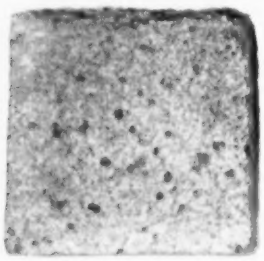
The Bosh brickwork must withstand high temperature, erosion from the tuyere blast, and chemical attack from basic slags. In addition, the bricks must resist carbon monoxide attack, for while the face of the brickwork is well above the temperature of rapid carbon deposition, the carbon monoxide is reduced in the brick lining next to the casing, and disintegration results. In order to meet the requirements of refractoriness, refractoriness under load, resistance to slag attack, carbon monoxide attack, etc., it has been found suitable to use bricks of the 42-44 per cent. alumina type in the Bosh.

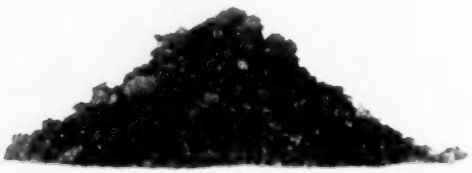
Hearth bricks are subjected to considerable pressures from the molten iron and slag; as a result they tend to contract, and in extreme cases the iron penetrates the joints and the bricks are forced to the surface of the metal, where they float until they are dissolved by the slag. The bricks in the hearth are not attacked by the molten iron in a chemical manner. However, if any oxidation takes place from air leaks, ferrous oxide is formed which attacks firebricks violently.

The present trend in hearth construction is to use carbon bricks throughout. These bricks, which do not shrink in use, and which do not permit local oxidation, are machined and fit into position without jointing compounds. There is still some disagreement about the advantages and disadvantages of large and small blocks.

In addition to the type of brick employed, the conditions of the furnace operation affect the life of the lining to a marked degree. High blast pressures give rise to excessive erosion; too rapir blowing-in will spall the structure; channelling may allow the bulk of the upward blast to scour the refractory lining.

Certain steps may be taken to protect the furnace lining. For example, water cooling in the Bosh walls





(Courtesy, J. G. Stein and Co. Ltd.)

Fig. 2. (Top, left) a. (Top, right) b. (Bottom) c.

AUSTRALIAN

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increases the temperature gradiant and thereby reduces the penetration of corrosive slag. The throat of the furnace is often protected with steel plates. When this is the case, care should be taken to keep the temperature below the deposition point of carbon.

Hot blast stoves which preheat the furnace blast contain a checkerwork of refractory bricks which alternately take in and give out heat to the reversing gas/air flow. These bricks are usually the 39 per cent. alumina type, the important feature being that they do not spall and do not build up with viscous slag.

Cast Iron

Cast iron is melted from pig iron in a miniature blast furnace or cupola.

The charge usually consists of pig iron, scrap iron and coke, with sufficient limestone to flux any sand which may be adhering to the pigs, and ash from the fuel. Air for combustion is blown through the tuyere feed from a main wind box. It is the general practice in Great Britain to use a cold air blast, although one cupola in this country operating with a blast of 200° C., is giving satisfactory results, although there is no apparent decrease in refractories consumption.

The cupola is satisfactorily lined with firebricks of ordinary quality in the upper regions, while a better grade is recommended in the hot zone and bottom. For instance, a 35-37 per cent. alumina brick is considered to be suitable for the hot zone, while a 30-32 per cent. alumina brick is adequate in the higher zone. Owing to the high rate of wear of the refractory lining in the hot zone, it is necessary to patch the worn brickwork every day. The usual mixtures for this purpose consist of quartzite (e.g. ganister) and fireclay.

Steel

Steel is usually manufactured from pig iron and scrap iron by removing carbon and other impurities at high temperatures. The nature of the refractory lining largely determines which impurities are removed; limestone in the batch assists in forming a slag. When the steel furnace is operated in conjunction with the blast furnace, the pig iron is run direct from

the tapping hole into a large reservoir called a mixer, from which the steel furnace is charged.

The four main types of steel furnaces used today are:

(a) The open hearth (acid and basic).
(b) The Bessemer furnace (acid and basic).
(c) The electric arc furnace.
(d) The high-frequency induction furnace.

The Basic Open Hearth Furnace

In principle this is a reverbatory furnace, i.e., one in which gases are burned over the charge. The products of combustion pass through regenerating checkers to the stack. After a suitable period the direction of flow of gas and air is reversed, and this process is continued, during which time the melt in the hearth of the furnace is reduced in carbon content, and phosphorus is eliminated.

The roof of the furnace, until recent years, was constructed almost exclusively of silica bricks, owing to their excellent refractoriness-under-load properties, and their good resistance to spalling. During the last fifteen years a considerable number of roofs have been built in chrome-magnesite. Although this allows greater working temperatures and, as a result, higher outputs and greater fuel efficiencies, there has not been complete success in this country. Considerable success is said to have been attained by constructing roofs of silica bricks manufactured from South African quartzite, this material possessing an alumina content of 0.3 per cent. (J. H. Chesters: "Recent Advances in British Open Hearth Furnaces." *Refractories Journal*, October, 1951.).

The hearth of the furnace from the the steel shell to the basic layer, is constructed of firebrick. (Insulating bricks may be used, but it is important to note that decrease in temperature gradient through the firebrick lining brought about by a course of insulation, will give rise to an increase of slag penetration in the lining.) Several courses of basic bricks follow the firebricks; magnesite bricks are commonly employed. During the last ten years it has become the practice to use stabilised dolomite clinker in place of magnesite. The consumable part of the hearth is usually made by ramming in a mixture of graded calcined dolomite and coke. As this mixture is consumed, the hearth is "fettled" with either raw or semi-stabilised dolomite. Hearth consumption rate increases when mobile slags are present, or when low-carbon steels are being produced.

The launder (the hot metal chute) is usually lined with firebricks, which are coated with a clay/quartz mix such as ganister.

The front and back walls originally constructed of silica bricks are now almost entirely constructed of chrome-magnesite or metal-case magnesite bricks.

The gas and air ends are generally built in silica or chrome magnesite, the choice being influenced by the type of fuel used. Producer gas gives a long flame which plays on the opposite end of the furnace, while the shorter coke oven gas flame is not so wearing on the refractories. Ports are almost always chrome magnesite. Slag pockets, which are situated at the bottom of the downtakes for the purpose of extracting dust and slag from the outgoing flue-gases before they pass into the checkers, are constructed of low-grade silica bricks. The design of checkers and the materials from which they are made have received considerable attention. Heat capacity, heat diffusivity, resistance to slag corrosion and dust erosion are important factors in the suitability of a refractory in checkerwork. In general, the top courses are built of silica bricks, which form a mobile slag and do not build up in such a manner as to prevent passage of the gases. Alternatively, 44 per cent. alumina bricks may be used; whilst these form a viscous slag, the overall attack by dust-laden gases is considerably less than the attack on silica bricks. Fireclay bricks are unsuitable for the tops of checkers.

Acid Open Hearth Furnace

The operation of the acid open hearth is similar to that of the basic furnace. The acid furnace, however, is usually much smaller, seldom exceeding 80 tons capacity. It is limited in its scope as the acid lining will not eliminate phosphorous from the metal during its run. As a result

the acid furnace accounts for less than 5 per cent. of all open hearth steel.

The furnace proper is built of silica bricks throughout, except for a few courses of firebricks under the siliceous hearth, and in some cases when chrome bricks are used in the ports. The monolithic lining of the hearth is obtained by fusing on layers of a mixture of high and low grade sands.

Bessemer Converters

The Bessemer converter is essentially an egg-shaped steel shell, lined with refractories. From 20 to 40 tons of molten metal are poured into the furnace. Air is blown through ports in the bottom, through the bath of molten iron, and in this manner carbon and silicon are removed from the melt. The metal throughput of these furnaces is extremely high, the production rate being approximately one hundred times greater per unit hearth area than the basic open hearth working on cold pig. Owing to the poorer quality of the Bessemer product, and because of the greater flexibility of the open hearth method, most of the world's steel is manufactured in the open hearth.

Hot Metal Mixers

Bessemer converters are fed with molten pig iron from a metal mixer—a cylindrical tilting reservoir fed from the blast-furnace. The lining for the acid process consists of an outer ring of insulating bricks, a ring of firebricks and a ring of silica bricks. The lining for the basic process has an outer ring of insulating bricks, a ring of aluminous firebricks and a ring of magnesite bricks. The roof may be a segment of silica bricks.

The Basic Bessemer

The side lining is usually made from a calcined dolomite/tar mix, either in the form of blocks, or rammed; a good lining lasts for about 200 "blows." It is worth noting that iron of a high silicon content will have a dilatereous effect on the lining, as will long blowing to remove phosphorus. The bottom of the basic converter is generally of monolithic construction and is pressed from mixtures of calcined dolomite and tar in special machines which form the tuyere holes. Alternatively, the bottoms may be formed by casting or pressing dolomite/tar mixures round preformed magnesite tuyeres. The addition of 5 per cent. carbon to the mixtures is said to give the bottoms an increased life. (The average "bottom" life is about fifty "blows.")

The Acid Bessemer

The side lining of the acid converter is usually constructed of silica bricks, while the bottom or "plug" is made by casting or pressing fireclay/silica mixtures round pre-manufactured fireclay tuyeres. The side lining can be expected to give 400 "blows," while the "plug" does well to withstand forty "blows."

The Electric Arc Furnace

Although the arc furnace does not account for a large proportion of the total output of steel, it is becoming increasingly important where steels of extra quality are required. The direct arc furnace of the Heroult type is most generally employed. Here three electrodes protruding through the roof strike arcs to the charge, which becomes the resistance and thereby continues to heat until it melts. Some electric arc furnaces are lined with acid refractories; this applies mainly when the object is to remelt good quality scrap steel. The bulk of electric arc steel furnaces are of basic construction, the sub hearth consisting of magnesite bricks, the side walls of magnesite, chrome magnesite or dolomite bricks, and the roof of silica bricks. The hearth proper is usually formed by sintering on to the magnesite sub-hearth layers of tar/calcined dolomite mixtures containing carbon.

High Frequency Induction Furnaces

The most satisfactory basic material has been shown to be graded dead burned magnesite rammed round a steel liner. Of the acid materials, graded quartzite is almost universal, ganister being the usual material employed.

Casting Pit Refractories

The sizes of ladles vary considerably; it is quite common in the open hearth process to employ ladles of 100 tons capacity. Ladle bricks should be capable of withstanding abrasion by the pouring metal, corrosion by the molten slag, spalling from the rapid

changes of temperature during filling and pouring. They should possess a low thermal conductivity in order to prevent the formation of "skulls" and should have good shape to prevent metal penetrating large joints. It is not possible to have all these properties in one type of brick. For instance, although basic bricks would give excellent resistance to slag attack and would be preferred because of the cleaner steel they produce, they would be unacceptable owing to their very poor resistance to spalling. The most usual type of ladle brick employed today is the fireclay brick, either the dense low-alumina brick or the more porous high alumina brick, the former resisting slag penetration and corrosion in a physical manner, and the latter in a chemical manner by producing a more viscous slag. Much success has been obtained recently with bricks manufactured from clay graphite mixes. Basic linings of dolomite bricks have been used with a measure of success, while they have excellent resistance to chemical attack, they build up with slag and metal which has to be removed after only a few pours.

There are a number of auxiliary refractory applications which have become important in recent years. These are the nozzles, stoppers and sleeves of the ladles, and the trumpets, guides and runners in connection with the ingot mould. Fireclay mixtures are used, attention being paid to porosity, spalling resistance, permeability, etc.

Soaking Pit Refractories

The soaking pit (in which the white-hot ingots are kept at temperature until they are used in the rolling mills) may be a simple coal- or gas-fired chamber in which the products of combustion pass to atmosphere, or to a waste heat boiler. More often the furnace is operated on the two-way regenerative cycle or the single way recuperative system. Many types of refractory have been used in the different parts of the furnace. The roof is generally built of 35-37 per cent. alumina firebricks; if an insulating course is used, 39 per cent. alumina bricks are used because of the decreased temperature gradient through the firebrick section. Side-walls are constructed of 35-39 per cent. alumina bricks except at the base, where they come into contact with molten scale. It is common to use chrome-silica bricks in these positions. The hearth materials vary considerably from one plant to another, but it is not uncommon to use a layer of chrome plastic above a fireclay floor. Often, coke breeze is used above the chrome layer to soak up the bulk of the molten scale.

MR. ASHLEY MYOTT

FOR twenty-three years up to the time of his recent retirement, Mr. Ashley Myott, chairman and managing director of the firm of Myott, Son and Co. Ltd., Cobridge, has occupied the chairman's office with the Wages and Conciliation Committee and the Wages and Advisory Committee of the British Pottery Manufacturers' Federation.

To his sound knowledge of the trade union side of the industry he added great skill as a negotiator, acquiring a reputation which is probably second to none in that capacity. Mr. Myott's contribution to the development of the principle of negotiation between representatives of employers and employees organisation has been a distinct advantage to the pottery export trade for which he has won recognition from both sides in the industry.

Mr. Anthony Adams of William Adams and Son (Potters) Ltd., Tunstall, follows Mr. Myott in the chairmanship of the two committees.

MR. P. CURNOCK

FOR sixty-seven years Mr. Percy Curnock of Tunstall has been making an outstanding contribution to the unfailing æsthetic appeal of hand-painted pottery. A fellow student with Arnold Bennett at Newcastle, Mr. Curnock opened an apprenticeship at the age of 13 with the Royal Doulton Potteries, Burslem, with which firm he has worked continuously. He recently celebrated his eightieth birthday, still working as a ceramic artist.

A specialist in scenic and floral designs, his signed pieces enjoy a circulation to all parts of the world. He has won a high reputation both at home and abroad whilst the student artist might take note of Mr. Curnock's practise of growing a wide variety of flowers in his own garden that he may closely study his subject before reproduction. To such a fidelity in treatment he adds a delicate artistry which he has continued to develop during his sixty-seven years as an artist to the pottery industry.

The Planning and Reconstruction of Pottery Factories

by

M. UPRIGHT, A.R.I.B.A., A.M.T.P.I.

SET as we are in the midst of lovely scenery, the industrialised area of "The Potteries" cannot be said to add to the amenities of the Midlands. The haphazard development of the district with its congestion of curiously-shaped kilns, not to mention the black smoke intermittently belching forth, have all combined to produce a depressing effect upon the beholder.

Pottery manufacturers in North Staffordshire have good reason to be proud of the beauty of their wares; unfortunately this cannot be said of many of the buildings in which these wares are manufactured.

Haphazard Development

Many pottery firms evolved from small beginnings, by the erection of a kiln in some restricted space. The enterprise prospered, other kilns and buildings sprang up, until every inch of available space was occupied. The buildings were often badly lighted and ill-ventilated and their haphazard development invariably resulted in a congested flow of industry.

As long ago as 1911 the late Mr. T. B. Johnston, speaking before the British Manufacturers' Commission declared that "in the Staffordshire District 60 per cent. of our potteries ought to be scrapped and modern works put up." In recent years considerable improvements have taken place, but it is safe to say that there is still a large percentage of works requiring reconstruction.

Modern developments in pottery manufacture have revolutionised the industry and these developments demand an altogether new layout in place of the old-fashioned "Pot Bank" with its open yards and huddled conglomeration of bottle-neck kilns.

For many generations right back to early mankind, the procedure of manufacture remained practically unchanged. That procedure has now been revolutionised more particularly by the use of the continuous tunnel kiln.

In planning any industrial building the designer must be familiar with the particular needs and requirements of the trade for which the building is to be erected; never was this more important than in the planning of buildings for manufacturing pottery. The evolution of the raw material into the finished ware and the complex processes by which this is achieved, demand expert attention, for these are matters which, more than any others, determine the entire layout of the building if it is to form part of a successful and economic business proposition.

The Site

With the coming into operation of the 1947 Town and Country Planning Act, and the zoning of areas for prescribed uses, it may (and I use the word advisedly, pending the result of the Fenton Inquiry)—it may be necessary in the not too distant future for some manufacturers who find themselves in non-industrial zones to look for new sites. In all such cases, manufacturers should consult an architect before any site is purchased or any contract made. Many factors require consideration before a site is selected—the cost of the site and of its development; the amount of the Development Charge which is likely to be determined; the nature of the subsoil; whether it is made ground or

Mr. Malcolm Upright, of F. V. Hulme and Upright, Chartered Architects and Town Planning Consultants, addressed a meeting organised by the Ministry of Works and the North Staffordshire Architectural Association, on the 10th March, 1952, at the North Staffordshire Technical College.

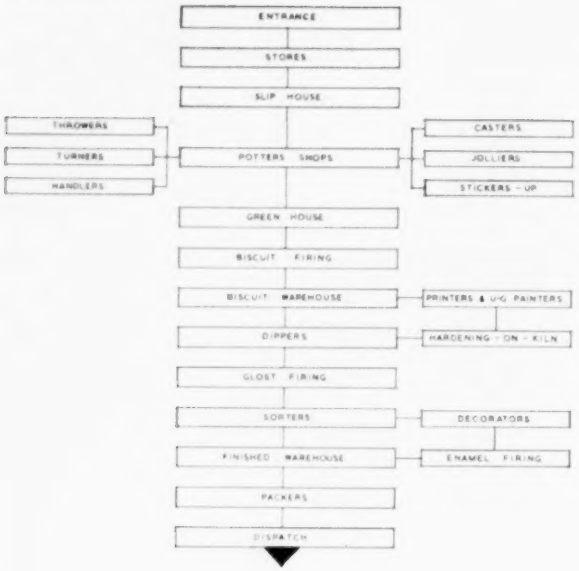

Fig. 1. Skeleton flow of production

virgin; its freedom from water; the contours of the land and the possibility of mining subsidence—all these are important points to be considered. So, also, are the town planning restrictions, local bylaws, the availability of essential services such as sufficient depth of sewer to drain the whole area of the site; adequate pressure of water in suitable mains, gas and electricity mains and the disposal of rubbish. Room should be found on the site for the parking of cars, motorcycles and cycles and, in addition, the Road Traffic Act stipulates that the handling of goods and a turning space

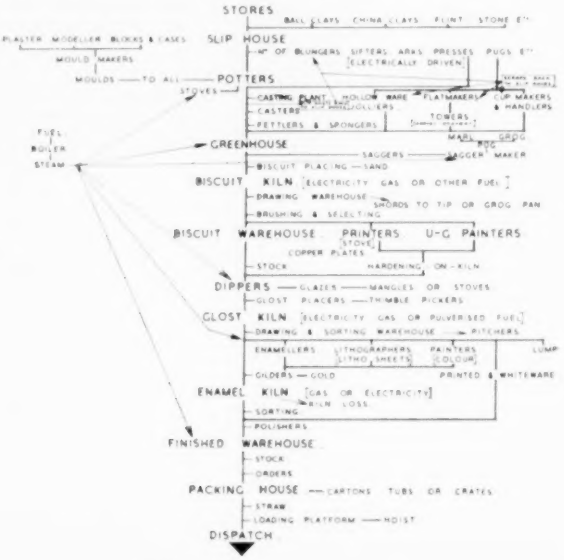

Fig. 2. Detailed diagram of the flow of production

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for vehicles should be provided for within the curtilage of the site.

Generally speaking, most manufacturers do not gain any appreciable advantage by building factories on main road frontages; to do so does not warrant the increased site costs and it is better to look elsewhere for a site which will probably cost less and not attract such a large Development Charge.

New sites should have ample room for enlargements over and above immediate requirements. They should be as free as possible from dust and noise. For instance, Mr. Josiah Wedgwood, giving evidence at a Government inquiry in 1939, stated that "the two main reasons why his firm decided to remove was owing to mining subsidence at Etruria, whereby the works had sunk, in places, 7½ ft., and also the large deposits of dust and smoke from the adjacent Shelton Iron Works resulting in specked ware, causing a loss estimated at £3,000 per annum." I have no doubt that the figure would be much greater on today's costings.

In illustrating the actual layout of the buildings in this paper, I have thought it best to confine myself to diagrammatical layouts of what appear to be small factories. The illustrations show the principles of planning to be adopted and are equally applicable not only to the largest factory but also to existing factories where it is intended to carry out programmes of reconstruction or re-organisation. There is nothing more enlightening on completion of the survey of an existing pottery than to indicate on the plan by coloured line the tortuous route taken by the ware in its journey through the cycle of production from the raw materials stage to its final exit through the packing house. I carried out this experiment on a factory having at the time, both a white and a red sliphouse and found that the crossing and re-crossing of the white and red ware was such that it seemed a wonder to me the final output was not some species of half-caste pottery. The result of this was that we were able to re-organise the production of this factory

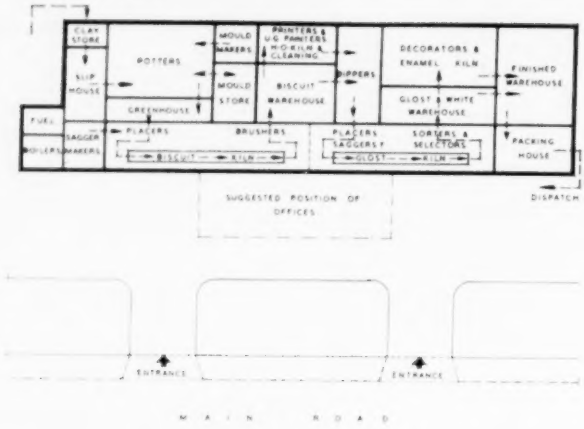


Fig. 3. 'Straight Line" layout type

and achieve a considerable economy in terms of distance of travel which contributed to the efficiency of the firm with comparative little expenditure on new buildings.

The chief aim of all good pottery planning is to secure a continuous flow of production from the entrance of the raw materials to the dispatch of the finished ware.

For those of you who are not particularly acquainted with the industry, Fig. 1 illustrates a skeleton flow of production in a pottery. The flow of production varies considerably, and it will be found that no two potteries are alike in their requirements. It is, therefore, necessary that the architect should not only study the manufacture as a whole, but also the peculiar needs and processes of the factory with which he is immediately concerned. To do this it is well to prepare a detailed diagram of the required flow of production as a first step towards the planning or reconstruction of a particular pottery. Fig. 2 illustrates the diagram of a pottery prepared in the manner recommended, and from this the design may be developed.

Size of Departments

Having determined the production which is to be housed, the next step is to obtain the requisite information concerning the relative size of the various departments for accommodating the different processes. Here, guidance will be sought from the manufacturer concerned, who, by consideration of the output required, will be able to determine the quantity of clay body to be prepared in the slip house, the capacity of blungers, presses, arks, etc., the number of machines, the area required for storage of raw materials and the number of workers required to supervise the machines. Having determined the total output it is possible to calculate the number of potters and machines, the capacity of kilns and the space required in warehouses and decorating departments, etc. Armed with this information, the architect may go on to determine the approximate floor area required for each process, having in mind the standards required by the Factory Act to prevent overcrowding by providing a minimum of 400 c. ft. of space for each person below a maximum height of 14 ft. from the floor level. In this way the relationship between the various departments, their size and proximity may be determined, and the planning proceed on a definite basis.

There is a general agreement that, wherever possible, potteries are better built on a one-floor layout system. Unfortunately in the past, restrictions of site and the inflexibility of building materials have invariably dictated multi-storeyed structures with increased carrying distances and deplorable daylight standards of illumination.

Advent of Tunnel Kilns

With the installation of the tunnel kiln into existing factories, a clearing away of these ill-lighted buildings has taken place, and the passages and yard areas have been brought into

full and valuable ground-floor use. Where dimensions permit, factories built on new sites should follow the principle of the single-storey layout. The advent of the tunnel kiln, with its ingress and egress at either end, has made it a practical proposition for departments dealing with the processes normally taking place between the intervals of firing to be housed in the intervening spaces between the ends of the kilns. This system is obviously more direct than the multi-storeyed factory, since all processes are under one roof and adjacent to each other, thus eliminating the wastage of labour, time and breakages in carrying ware from one storey to another, and between separate buildings. There is also the great advantage of adequate and evenly-distributed daylight illumination being available over the whole of the floor area.

Notwithstanding these remarks, it will, obviously, not be possible to erect every pottery on a one-floor layout system. Restrictions of site area will still prevail, and in large factories it may be considered desirable to have decorating shops, for reasons which I mention later, and possibly some of the potters' shops on an upper floor to retain the area of the factory structure within reasonable limits. The method of approach to the planning of such a factory still remains in accordance with the flow of production and the principles which have already been considered. Later, the suggested section of a two-storeyed factory is considered so that open yards and passages are avoided.

Straight-line Layout

Fig. 3 shows what I have called a "straight-line layout type," which provides for the entrance of the raw materials at one end, and the despatch of the finished product at the other.

The consecutive processes and departments which the ware enters are adjacent to each other, thus insuring easy management and supervision through the entire works. This type of plan is suitable on a large site or on one with a long road frontage, or alternatively, it can be adapted to a narrow site with a reasonable depth in which case the "clay end" would be at the rear of the site and the finished warehouse and packing house adjacent to the road frontage.

Any future extensions could be provided without altering the existing flow of production or indeed interfering materially with the manufacturing process.

The offices, welfare departments and other accommodation may be planned in accordance with the requirements of the manufacturer either as part of the factory structure or alternately as a separate unit in conjunction with the mess rooms, etc.

Fig. 4 shows a suggested right-angle layout type suitable for a more restricted site or where the levels do not permit economically a long

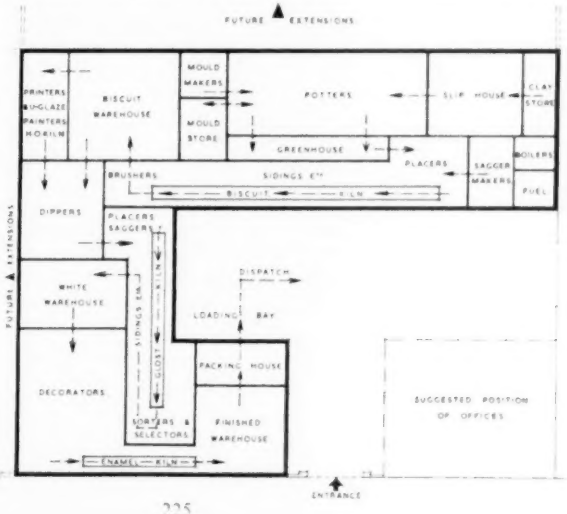


Fig. 4. "Right Angle" layout type

structure. It is preferable to plan the kilns on the internal angle of the pottery so that they do not interfere with future extensions on the outer side. Offices and showrooms may, with advantage, be planned to give easy access to the finished warehouse as part of the main structure, or again as a separate building with covered ways to the factory structure.

Fig. 5 illustrates a layout with a complete cycle of production. The preparations and processes up to the biscuit stage are down one side of the factory and the glost stage to the finished warehouses on the return side.

The arrangements of having the kilns together gives the kiln attendant simultaneous supervision over both and, if necessary, can provide economy in labour in placing and sorting.

Extensions may be provided at the rear or on either side, again with little interference with the manufacturing processes while the office and other accommodation can be located adjoining the finished warehouse.

The diagrams you have seen have been prepared to illustrate the method of approach under various circumstances to secure the continuous flow of production which is so essential to business success. In each of the examples considerable distances are avoided between continuous and consecutive processes proximity results in easy management and economy in production.

Detailed Planning Considerations

It will soon be discovered in considering the general layout of a pottery that a knowledge of the detailed layout and the requirements of the various shops are other essentials for successful work.

The provision of covered stores is necessary where large stocks of materials are held, etc. The amount of accommodation required for storage varies considerably between potteries, according to the types and class of ware being manufactured.

In Fig. 6 I have suggested alternative arrangements. The first is suitable where only a few varieties of clays are used. The door for receiving the material should be at least 3 ft. 6 in. from the ground so that the materials may be conveniently delivered from the lorries. The second arrangement is suggested for a factory using a large variety of materials in circumstances where it is impracticable to plan all the bins on an outside wall. Manhole covers are provided over each compartment and a light tipping lorry used to deliver the materials.

In this paper, illustrations of the machinery layout of slip houses are omitted since the detailed requirements are the main concern of the pottery engineer, and they vary considerably according to circumstances. The layout should be arranged in conjunction with the architect who will give particular attention to the height required for the various plant instal-

Fig. 5. "Complete Cycle of Production" layout

lations and the structural necessities.

The slip house accommodates practically the whole of the heavy machinery and here again the flow of production should be maintained from the entry of the raw materials into the blunger and on to the stages of lawning, magnetting, mixing and through the press and pug mill to be delivered in a homogenous mass ready for use in the potters' shops.

With the improved lighting facilities provided in the potters' shops by the use of single-storey factory construction, the necessity of placing the benches along the walls immediately in front of windows with the drying stores in the centre of the shop disappears, since adequate light should be available in all parts of the shop. This facilitates, if it is desired, the setting up of series of complete "single making units"; each potter being provided with a stove and the "tower" having a position immediately adjacent for fettling and sponging the dried wares as they are taken from the stove. This arrangement was adopted quite frequently just before the war, but I think it is now generally considered more desirable to keep the towers together, thus more easily and economically providing the exhaust draught and ducting necessary for this process. Each manufacturer has his own predilection respecting the drying stove most suitable to the particular type and range of ware he desires to produce. They should be of the totally-enclosed type and designed to ensure the main requirement —the efficient drying of the ware and the prevention of back draughts into the workshops.

Since preparing this paper, there have been reports of a new and notable idea developed by J. and G. Meakin Ltd. of obtaining this desiderata. The new arrangement is an advance on the principle of the "single-making units" previously referred to. With the use of a conveyor receiving the ware from a series of makers and conveying it through a large drying room outside the making shop, a complete "multi-making unit" is formed, the towers carrying out their work on the return side of the

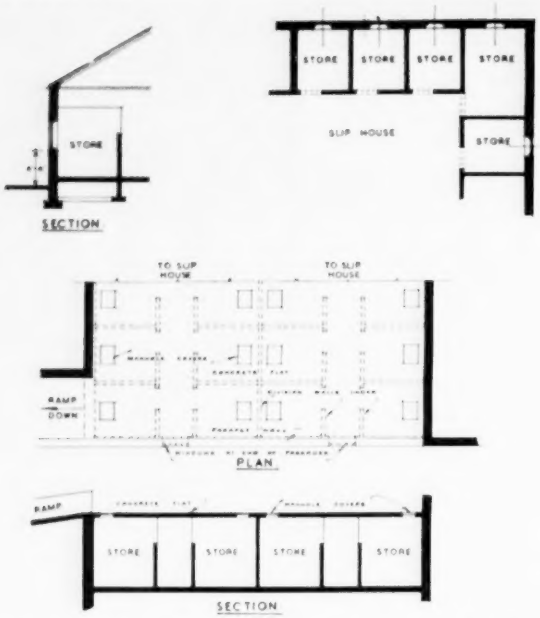


Fig. 6. Arrangement of clay stores

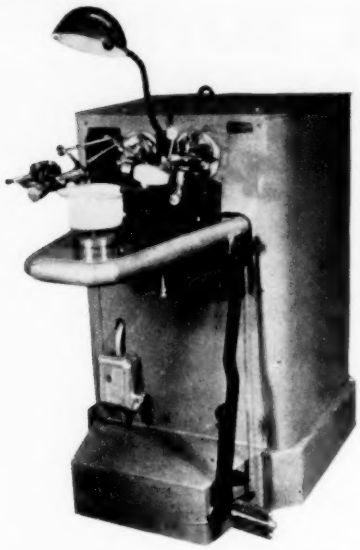
conveyor before the ware is placed on trucks for dispatch to the greenhouse.

I have had the privilege of inspecting this new arrangement and there being no necessity for the operatives to enter the drying room, which is completely outside the workshop, the conditions for the employees are undoubtedly improved. I think there is little doubt that its use will commend itself, particularly to the larger manufacturers, since it provides increased production, easy supervision and inspection of the ware, economy in floor area and cost of installation and maintenance, compared with the provision of the number of unit dryers which would be required for an equivalent output.

The mould-making shop should be so situated that moulds are readily available to the casting shop, and immediately adjoining this department a large "block and case" store should be fitted with pens so indexed that any block or case may be produced at once when required. The dipping house should be so arranged and situated that the glaze may easily be received in small agitating tanks. The ware should also have easy delivery from the biscuit warehouse, printers and underglaze painters. The departments for the decoration of ware must be spacious, well lighted and of easy extension. The gas- or electrically-fired enamel kiln may be situated in the decorating shop without disadvantage. When used, as often happens, for both hardening on and enamelling, the kiln may be placed in a separate department, though care should always be taken to give the placer an adequate selection of wares to draw upon.

In some factories it may be an advantage to plan the decorating shop on an upper floor; no difficulty arises in installing the enamel kiln, and adequate daylight is available in such a position. This arrangement provides more space for other departments which are better situated at ground floor level.

The various warehouses throughout the factory should be so arranged that the whole of the stock is readily accessible. The dimensions of the warehouses is largely dependent on the size of the ware produced—flat ware which may be stacked requiring much less space than ornamental wares. The finished warehouse requires careful consideration for this is where orders are made up and efficiency and accuracy combine to



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promote business success. The pens for stocking ware should be readily accessible to the warehouseman engaged in making up orders and an adequate space provided in the middle of the floor between the pens for this purpose.

The use of straw in the packing of the ware which must be stored in a fireproof building makes it almost the universal custom to provide a fireproof loft over the packing house, which seems the best and obvious method to employ. The packing house should have direct and uninterrupted access to a loading bay which, where possible, should be raised 3 ft. 6 in. above the level of the drive to permit easy loading of the vehicles.

(To be continued.)

A HAPPY CONCLUSION?

IN CERAMICS we have followed closely the negotiations on the cost of gas to the pottery industry. Readers will remember the reference first to the local gas board, in turn referred to the Consultative Council, and in turn rejected to the British Pottery Manufacturers' Federation by the Gas Board. Then the North Staffordshire Chamber of Commerce took up the question with the Gas Board who said that the increase in the cost of gas was due to the importation of coal from the North-East and the export of gas coal from North Staffordshire elsewhere.

It is now learnt that the North Staffordshire Chamber of Commerce have negotiated with the various authorities and the local Gas Board is to receive its coal from the West Midlands Coal Board, and the Gas Board in turn have stated that this will save about £30,000 per annum. Presumably the Pottery Manufacturers' eagerly await the implementation of reduced gas tariffs, based upon reduced coal prices.

Or will another red herring be introduced?

Bentonite from Greece. British and Overseas Minerals Ltd., Creechurch House, Creechurch Lane, London, E.C.3, are now importing bentonite from their mines in Greece. No import licence is required.

PROBLEMS IN BUYING REFRACTORIES

By

D. WRAGG, M.P.O.A.

Purchasing Director, Thomas Firth & John Brown Ltd.

It was thought that makers of refractory materials would be interested in the views of a buyer. For the customer is now getting to be "right" again.

YOU are no doubt accustomed at your meetings to listening and discussing matters scientific. I lay no claim to little more than a layman's knowledge of refractories but I have bought considerable quantities of many types and have spent a great deal of my firm's money and a lot of my own patience in pursuit of this work, and you may find some interest in listening to a few of the problems confronting the buyer in this section of his responsibilities.

Basically, the operation of buying generally may be divided into two essential parts. First, the buyer must seek out the commodity which he requires and ensure that its specification closely accords with his own requirements. Secondly, he must be able to negotiate a purchase price which in the circumstances is as favourable as possible to him and within his capacity to pay. Quality, supply and price and the necessary legalities are regarded as the foundations upon which the buyer's work is built.

A Buyer's Responsibilities

The buyer's job is to co-ordinate under one head the spending of all the firm's money required in obtaining raw materials for production, items of maintenance and capital expenditure required by his company for the conduct of its business at the most economical level.

He must know his quality first and foremost, and see that he obtains the most satisfactory terms and conditions of contract. He must arrange delivery dates to ensure an uninterrupted production schedule, keeping in mind that it is uneconomical to invest more of his firm's money at any one time than is essential. Having reached this stage he must be in a position to ensure that he receives what he asks for by verifying quantities, testing and inspecting materials as they flow into the works, and ascertaining that what has been charged is in accordance with contract terms. He controls all stores and their distribution, charging the various plant concerned with what they have consumed. He maintains a market research and is armed with knowledge of the location of all acceptable sources of supplies, and tries to be familiar with the nature of new products of economical value to his firm.

Unfortunately, these general principles cannot be applied to refractories—a fact I will enlarge upon later.

The average amount spent by industry on materials of all kinds is about 65 per cent. of a firm's income, the remainder being largely spent on wages and taxation. For this reason buying is an excellent subject for substantial economies. I merely mention this to emphasise that as buying is the first operation in the industrial cycle, unless we buy right we cannot sell right, and that in many firms a matter of a small percentage up or down in the cost of supplies, represents the difference between a loss or a profit.

Considerations in Refractory Buying

In the steel industry, refractories obviously represent a highly important

An address at a meeting of the Refractories Group of the Sheffield Metallurgical Association, 25th March, 1952. Reprinted by permission of the "Purchasing Journal" published by the Purchasing Officers' Association.

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figure of cost, in the way of new furnaces and maintenance, and it is highly important that a watchful eye be kept on every stage of buying, or obviously the refractories feature of melting costs would be altogether disproportionate. Unfortunately, the buyer's hands are tied to some considerable extent. He has little control of two main features, namely, quality and price.

No one appreciates more than the buyer that although he may spend a life-time in an industry and is able to carry the responsibility entirely for a great deal of that he buys there are many products, including refractories, on which he must depend on his scientific colleagues for guidance as to the particular nature and types that are best suited in every way to a particular application, and I receive a great deal of assistance from my technical colleague, who has kindly promised to reply to any technical questions I am not qualified to deal with.

Refractories are, as we know, of such fundamental importance as to warrant a refractory research branch in the more important firms, and the smaller firms who cannot support this must depend on the knowledge and guidance of some one in their firm who is able to give guidance. There are others who rely on recommendations of refractory firms, an alternative I do not entirely favour, and I am of the opinion that firms whose capacity is not large enough to warrant a specialist might well employ an independent consultant.

In the buying of refractories as in other materials, the first step is to know your requirements, and this can only be ascertained by careful review of past consumption and furnace life under certain known conditions of your firm's trading, and to compare this picture with the prospects of your firm's business in one, two or three years ahead by keeping abreast with the country's economical trends, and to see that the requirements of sizes in each quality are not disproportionate, so that the building and maintenance programme may proceed without hindrance. In my own case

we have to consider keeping the works supplied with 450 different types and sizes of silicas, English and Scotch firebricks, basic, insulation, and general pit refractories, representing about three million items a year, with delivery dates varying according to types of refractories, from early delivery up to about three years. One can only hope that after every consideration has been given the estimate is at least intelligent and finds itself somewhere near the truth.

A Slapdash Method

The only alternative to this careful scrutiny is the slapdash method of contracting for quantities well in excess of probable requirements, i.e., to make sure by ordering well in excess needs that refractories will be available.

This method is likely to give rise to very serious complications. In the first place—and this is very important—the supplier firms will have exaggerated views of the actual future demand, a feature which no doubt causes production difficulties in the refractory industry as similar over-ordering does in all industries. Secondly, it will be necessary to cancel, or suspend deliveries when normal trade returns. No supplier, at the moment, will object to cancellation, but a return to a buyer's market, which may seem remote but will arrive with an improvement in international affairs, might mean that a buyer must accept delivery of refractories far in excess of requirements, or arrange cancellation of his contract. But we must bear in mind that a seller is not obliged to accept cancellation and could enforce damages to the extent of the cost of production at the time of cancellation.

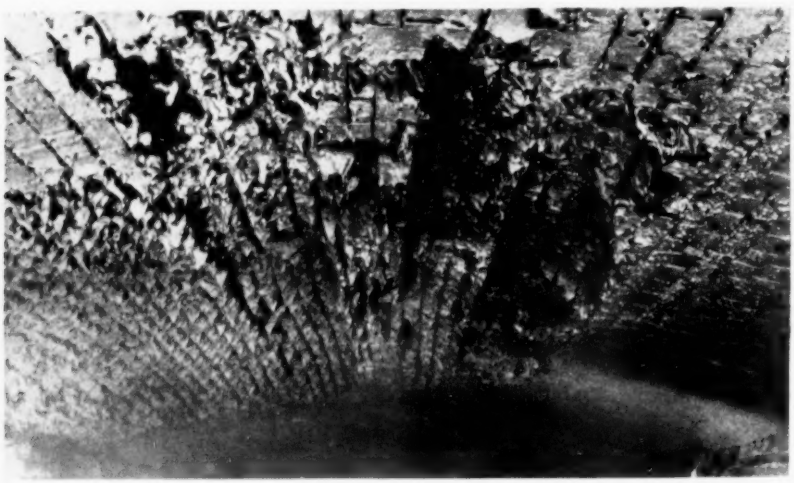
Or thirdly, it leads to overstocking for a considerable period resulting in a financial outlay far in excess of what is necessary, and in the interests of economy no firm can afford to spend money on idle stocks with prospects of deterioration, and requiring valuable stocking space.

All these three positions are dangerous.

Although I know refractory firms make every effort to deliver on the date promised, in very many instances this is not implemented, and therefore the buyer must be prepared to carry stocks to safeguard requirements for furnace building and maintenance—a feature I will touch on later.

Choice of Supplier

Having ascertained the quality and number of refractories required over a period, the next step in the buying



(By courtesy, Thos. Firth and John Brown Ltd.)

Siemens furnace roof after 170 heats

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process is the choice of supplier. As in the buying of other materials, it is wise to have more than one supplier for each grade of refractory. I feel it safe to say that even in normal times no supplier is capable, over an extended period, of meeting all commitments for quantities and types required at the time called for. This is my experience. Refractory firms have the same misfortunes as other manufacturers in the way of mishaps, difficulties with raw materials and labour, weather conditions, reorganisation of plant and so on, so the buyer who must maintain furnace life at all costs, shares the contracts.

With the exception of certain special types of refractories the choice of suppliers is arranged for the buyer for the obvious reason that the refractory industry has, to a large extent, grown and prospered in a natural way around the steel industry and in the same locality, the one being dependent on the other. It is a great advantage that both parties should be able to rub shoulders in this way because in the main it means the local refractory makers are steel minded and steel folk are refractory minded, and to some extent familiar with problems in each others industry likely to affect both parties.

Now, in the normal way of choosing a supplier the fact that a firm may produce the material you require is, of course, by no means the final consideration. Price is, without question, a feature of major importance in any purchase transaction, but to the uninitiated it is a highly rated factor. No honest purchasing man will deny a keen interest in price, but he will be just as honest in saying that price is generally the last factor to be considered, because needless to say it is meaningless unless associated with quality, first-class service and continuity of supply.

Price Fixing

When you buy on price you can never be sure. It is unwise to pay too much, but it is worse to pay too little. When you pay too much you lose a little money—that is all; but when you pay too little you sometimes

lose everything, because the thing you bought is incapable of doing the thing it was bought to do. The common law of business prohibits paying little and getting a lot. It just cannot be.

Unfortunately, to the buyer's considerable disappointment, the prices of many refractories are arranged by an association, and are strictly adhered to by all parties. Purchasing officers have very mixed feelings, and sometimes very strong objections to price-fixing arrangements, although no doubt all our firms are a party to at least one similar arrangement.

Back-door Methods

There are excellent features within the framework of a trade association, and a wide difference between trade associations and those bodies whose aim is merely to control prices at which members should sell. Under such an arrangement the prices fixed may be based on the costs of the more inefficient members, which is a real danger to progress, and we have observed the back-door methods of unscrupulous firms who are a party to price fixing, but under pressure and in bad times avoid their responsibilities under the agreement. There are efficient firms, and shall we say, not so efficient, in all trades, and some firms may have manufacturing advantages not possessed by others, and are able to work on substantially lower overheads, but it is quite certain that prices are not based on the lowest costs as revealed in the cost accounts of the highly efficient members, or some party firms would soon be in serious difficulties, or out of business. But whatever the merits, or de-merits of associations, it is sufficient at the moment to say, that the main refractory prices for similar products are controlled.

Unfortunately for the buyer, this equalisation of refractory prices is in no way linked up with a standard performance of the bricks, and there are differences, sometimes wide, in the quality of bricks received from various sources, and indeed from the same source.

I understand from my buying friends in the U.S.A. that in their country prices are substantially uniform throughout the industry for a given grade of product. But products are sold under broad grade classifications, i.e., ordinary, first quality, super quality, etc., and there is a price for each quality.

Also there is a scale of quantity discounts which give a price advantage to the purchaser of the large quantities. In this country there is no such advantage to a large user in spite of the fact that important quantities ordered make for lower production costs.

Therefore we find ourselves not only in the position of accepting a controlled price to cover quantities large or small, but have no guarantee of performance to an agreed standard, a truly sorry position, existing in no other industry I know of. There can be no doubt that the consumer has a very unequitable arrangement placed upon him, which restricts the real art of buying. At the present time it is one from which he cannot escape due to the seller's market which has existed for over a decade, and to the fact that there is no agreed standardisation of quality between buyer and seller. If it is really necessary for the industry to fix the price at which all members shall sell, in common justice it should be arranged strictly according to the quality supplied by each firm.

Standards of Performance

I do not suggest that this question of standard performance is being allowed to drift because of the advantageous selling position of refractory firms over so long a period. It has been said by those qualified to judge that this position is brought about by lack of real competition in the industry, although for my part, I have noticed over the last year or so, a considerable increase in the number of firms outside this locality who are seeking to introduce themselves into the Sheffield market, and it may be that competition of this sort, in more difficult days, will result in some serious action being taken by the refractory industry in collaboration with the steel industry in standardising performance and offering consumers a fair and normal business arrangement. I do not doubt that this is a problem capable of being solved, as our late friend Dr. Rees mentioned, in commenting on a Paper I gave to

the Refractories Association four years ago, that purchasing officers may be helped in the near future by the deliberations of a Committee of the B.S.I. which was hoping to prepare specifications for refractories for particular uses, and would enable purchasing officers to get precisely what they want from the producers. I have heard nothing of the progress of this Committee, but no doubt something is being done.

In the field of scientific purchasing one of the buyer's responsibilities in respect of *all* materials purchased is that of inspection. The question he struggles with is: "Have they given me what I bought?" You study the manufacturer, analyse the market supply, make standards of your wants—excluding refractories—specify these needs in your contracts—and then the whole scheme falls flat unless you check to see that the supplier has lived up to it. You test and inspect. Prompt inspection saves annually a large amount which would otherwise be lost in short deliveries, accidents or substitutions. Experienced men are encouraged to remain in the receiving department, and their years of service are a great help in protecting the concern as to right quantity and quality in every delivery. Thorough inspection at the receiving door is essential, if you are to receive right quality and honest quantity in the goods ordered. Buying by test demands delicate and complicated instruments which put the scientist at the buyer's elbow and supplement the expert's trained eye.

(To be continued.)

19th CENTURY POTTERY AND PORCELAIN

THE ceramic products of the 19th century were as varied as the multitudinous changes which marked its course from Regency to late Victorian and Edwardian times. Those who never knew the era are glad of it, whilst those who were acquainted with it speak mostly of its defects. Hence the vilifications which have been heaped upon that century to a great extent have served to hide its achievements and to give an impression that it was an anomaly in the history of England.

Despite these general impressions, in the ceramic field, for example, there were leavening features, and in a book published by Faber and Faber Ltd. (30s. net) entitled "19th Century English Pottery and Porcelain," Mr. Geoffrey Bemrose has put aside prejudice in pages of historical and descriptive matter,

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telling the story of pottery up to century-date, providing an artistic and technical appreciation suitable for both collector and student.

Out of the practice and experiment of the 18th century was derived that considerable knowledge and technical skill which resulted in the red body, the early work of the Elers brothers, undergoing further development in production and decoration, serving a considerable market as both glazed and unglazed domestic wares. The low-temperatured lustre wares were, of course, typical products of the early part of the 19th century being greatly varied in design and application, enjoying wide markets both at home and abroad.

Parian porcelain from an original composition of felspar and china clay became the subject of many changes providing ornamental oddities, particularly in single or grouped figures, which decorated the Victorian mantlepiece, changing it from Puritan simplicity to the burdensome ornateness. Especially outstanding was the wealth of output arising from the standardisation of bone paste, giving to the era some of its gayest productions in both design and decoration.

To flick through the 150 or so plates of this book shows a panorama of the century's output and the tremendous variety of wares which came from the industry's expanding production. The colour plates show the artistic achievements to the best advantage, compelling admiration even from the most critical observer. In these illustrations are to be seen the contemporary and traditional and if, as the author remarks, "there was a good deal of imitation of earlier period and foreign wares," this was not new to the ceramic arts; admiration encouraging emulation.

Profoundly influencing the developments in the pottery industry following the various Enclosures Acts, industrialisation, proceeding from one jump to the next, upset many social lines of demarcation creating the concentrated town populations, which were becoming more and more dependent for their daily requirements upon the manufacturers. These expanding home markets amongst new classes of consumers had a parallel in the fillip given to overseas trade by the defeat of Napoleon. The improvements in transport facilities completed the basis for the growth of specialisation and the tendencies towards mass production.

Design in general responded to the demands of the new markets and inevitably, in keeping with some of the worst features of the period, resulted in some positive horrors.

Despite this the idiom of the time is obvious and Mr. Bemrose's work provides a close acquaintanceship with the ceramic output of what was substantially Victorian England, noting its artistic qualities. To quote his final paragraph: "The inventiveness of the nineteenth-century potter in the spheres of materials, decoration and process, is unquestionable. His successes entitle him to an honourable place in ceramic history." This works gives him that place.

JOINT CONSULTATION

A SMALL booklet entitled "Works Committee Members' Handbook" has been published by the Industrial Welfare Society, at 48 Bryanston Square, W.1, price 2s. In thirty odd pages it sets out to give a background of information necessary to members of Works Committees: chapters cover the aims of consultation, the scope and power of the Committees, the drawing up of a constitution and standing orders together with some suggestions as to how consultation can be made to work. In two appendices there are useful hints in the form of a glossary of meeting procedure and one covering economic and management terms.

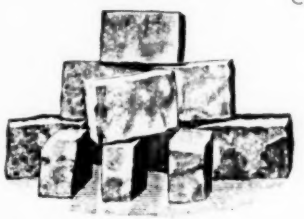
Undoubtedly this booklet is of real value to both sides of the Joint Consultation Committee. In its foreword the one claim to both sides is "be human"—it goes on to say that, "if your organisation and meeting etiquette is perfect, but people remain isolated as groups or individuals, you might as well drop the whole idea." Of course, the essence of joint consultation, as indeed in any other aspect of our business life, is summed up in the expression "be human"—nevertheless the innate selfishness of mankind still prevails.

Whilst one cannot say that reading the booklet will reconcile the paradoxical views of management and men on the thorny question of remuneration, nevertheless it is supremely useful in that it provides a good synopsis of information which many members of Joint Consultative Committees could read with profit. It is well worth providing for all members of works committees. It does bring out clearly the division of factory costing into prime or direct costs and indirect costs, between them contributing to the overall factory costs. It shows that on to this figure must be added administrative and selling costs to give a total cost, and that it is this figure to

which the profit is added to give a selling price.

If this lesson alone is learnt, then it will do much to avoid misconceptions which prevail about ultimate selling prices. Within the factory itself, only the direct labour factor contributing to factory costs, and the administrative and selling costs are subject to internal control, so that total costs are influenced directly only by the controllable factors of direct labour and administration. Since 75 per cent. of the profit is a direct payment to the Exchequer, it will be realised quite clearly by the Committee that far and away the greatest shareholder in any business in so far as dividend is concerned is Her Majesty's Chancellor of the Exchequer. He in turn wants selling prices down, but reduced profit means reduced national dividend. Therein lies the irreconcilability of costing "interests" irrespective of a right- or left-handed Chancellor.

At the recent International Congress on Ceramics, for which the "Ceramics" reporter's comment appeared in the June issue, Dr. Green was caught by the photographer in a very international setting—this photograph is published with acknowledgment to the American Ceramics Society Inc., and appeared in a recent issue of the Society's *Ceramic Bulletin*. Those shown in the photograph include, reading from left to right: Dr. Jean Sigg, Director Ceramic Laboratory, Lausanne; Dr. Gerald Hirne, Chief of Laboratories, Ceramic College at Sèvres; Dr. Louis Halm, Technical Director of the French Union of Refractory Products; Dr. John Chesters, President of the British Ceramic Society; Dr. Herman Salmang, Technical Director of Sphynx, Maastricht, Holland; Dr. A. T. Green, Hon. General Secretary of the British Ceramic Research Association; Dr. Isay Balinkin, the writer; Mr. M. Kantzer, Director of the Laboratories of the French Ceramic Society; Dr. A. Lanquine, Professor of Geology, Sarbonne University; Dr. J. Labansat, Director of the Professional Society of Heavy Clay Products; Mr. J. Menneret, Engineer of the Ceramic College at Sèvres; and Mr. Charles Kiefer, Chief of the National Manufacture at Sèvres.



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THE VELOFEEDER

HENRY SIMON LTD., of Stockport, England are now offering, under the above trade name, a vibrating feeder with wide range of performance and low power consumption. The system of impact producing the vibrations in the feeder is new.

The feed tray of the Velofeeder (which can be 12 in., 18 in. or 24 in. wide) can be regarded as a conveyor having a working stroke variable over a very wide range—from virtually motionless to a maximum of nearly ¼ in. at 1,850 vibrations per minute; the machine combines flexibility and a high maximum output. The motion of the tray is produced by an ½ h.p. motor driving a small rotating out-of-balance weight assembly that gives impulses to the "anvil" on which it is mounted, the anvil being so arranged that it can oscillate between springs. On its rearward movement the anvil collides via a rubber pad with the feed tray, which also oscillates between springs. The springs and mountings are so designed that the two masses—anvil and feed tray—oscillate in opposite ways and collide once in every cycle. The machine is virtually self-balancing and little or no vibration is transmitted to the frame. The force of collision determines the movement of the feed tray. Variation in the force of collision is obtained by altering the mean distance between the two masses. This is done by turning a hand-wheel.

The machine can deal with a wide range of materials as the motive force generated by the principle outlined above ensures that even the most difficult materials are propelled evenly along the length of the tray. It is claimed, therefore, that the feeder can handle many materials, which, by reason of high moisture content or other difficult characteristics, are outside the scope of conventional feeders.

The manufacturers can offer the machine with a variety of sizes and types of tray with local or remote control. An electronic Servo Controller can also be incorporated to give positive automatic adjustment of feed rates in proportion to any measurable variant. Examples of the uses of the "Velofeeder" in this connection are the automatic regulation of feed to grinders and pulverisers, thus maintaining maximum output and choke-free operation regardless of variation in material density, and the maintenance of temperature in dryers and roasters by automatic regulation of the feed.

Correspondence

CARBORUNDUM

SIR,—We note on page 191 of the June issue of CERAMICS a strange reference to the mining of a "carborundum deposit from Lake Superior" fifty years ago. We feel sure that in the interest of accuracy you would like us to point out that no such deposit ever existed. "Carborundum" (the registered trade-mark of The Carborundum Co., of Niagara Falls, U.S.A.) is, of course, manufactured silicon carbide and it is well known that The Carborundum Co. pioneered the manufacture of this most important electric furnace abrasive and refractory product well over fifty years ago and remain the world's most important producers today.

Silicon carbide is not found in the earth's crust, much less in Lake Superior, and it is therefore difficult to understand how any other company could have developed and mined such a deposit.

We should also like to point out that The Carborundum Co. Ltd., as one of the pioneers of flexible abrasives, had the major interest in Durex Abrasives Ltd., before the latter ceased operations.

Furthermore, the statements that "last year the 3M Co., accounted for 37 per cent. of the United Kingdom total trade in abrasives," and that they were "the largest United Kingdom exporters of technical abrasives," are only correct if understood to refer to surface-coated or flexible abrasives.

Yours very truly,
THE CARBORUNDUM CO. LTD.

G.E.C. Publication.—Under the title "G.E.C. Horizontal Batch Type Electric Furnaces," The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2, have produced a useful brochure dealing with furnaces for annealing, hardening, normalising, tempering, brazing, nitriding, malleablising, gas and box carburising, vitreous enamelling and special heat treatment. Throughout the description the importance of high grade refractory materials and the choice of heat insulating materials is stressed.

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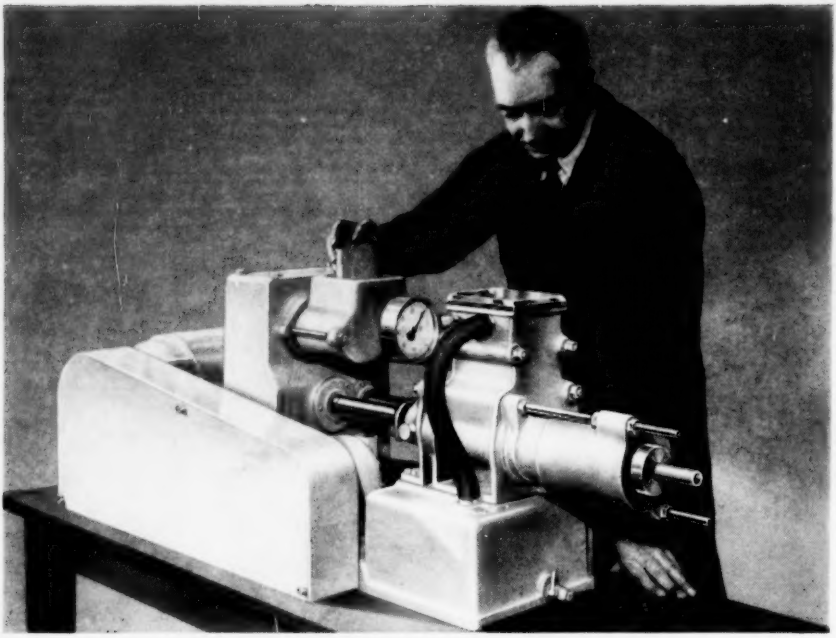

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